TOURISM AND CLIMATE CHANGE: AN INVESTIGATION OF THE TWO-WAY LINKAGES FOR THE VICTORIA FALLS RESORT, ZIMBABWE

by

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Dedication

To all climate change victims globally who suffer and will suffer as a consequent of climate change and my foster parents, my beautiful wife and daughter.

Declaration

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Tourism and climate change: An investigation of the two-way linkages for the Victoria Falls resort Zimbabwe

I declare that the above thesis is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Student Signature  Date 30 July 2018

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Abstract

There remain vast knowledge gaps in the global south as to how tourism will affect climate change and vice versa. Recent extreme weather events in southern Africa attributed to climate variability and change have led to speculation that, the Victoria Falls, is under threat from climate change. This research was aimed at examining the two-way linkage between tourism and climate change. The research adopted a pragmatism paradigm in a mixed-method case study. A number of research techniques were used to investigate the problem, namely: an online survey (n=427), secondary data analysis, field observation and interviews. Data analysis was done making use of Mann-Kendall Trend Analysis, QuestionPro analytics, Microsoft Excel Analysis Toolpak, Tools from ArcMap 10.3.1 and SPSS 24. Content analysis and thematic analysis was used to analyse secondary and interview data respectively. It emerged that the Victoria Falls is experiencing climate change, which resulted in statistically significant increase in temperature over the past 40 years of between 0.3°C and 0.75°C per decade. However, no significant changes in rainfall were noted, although there has been a seasonal shift in average rainfall onset. Weather extremes and annual rainfall point to increased occurrence and severity of extreme years of droughts and wetting which has in turn also affected waterflow regime at the waterfalls. The changes have a negative impact on wildlife, tourists, and tourism business in the area. The study also revealed that tourism is an equally significant driver of climate change through carbon emissions throughout its value chain. Carbon emissions from tourism value chain are set to increase in the foreseeable future despite efforts of going green by the industry owing to exponential growth of the industry. There is, therefore, a need for the industry to adapt, mitigate and intensify green tourism efforts to achieve sustainability. The study further suggests that there is a need for better communication and education to build resilience and capacity for the tourism industry to deal with climate change. Further research is suggested to ascertain the tourism threshold for the area, impact of climate change on wildlife and basin changes that led to water flow increase in the Zambezi River.

Key Words: climate change impact, variability, Victoria Falls, Zambia, Zimbabwe, extreme weather events, green tourism, sustainable aviation, Zambezi hydrology, Africa

Table of Contents

List Of Figures

List of Tables

Acronyms

AR4	Fourth Assessment Report
AR5	Fifth Assessment Report
CAMPFIRE	Communal Areas Management Programme for Indigenous Resources
CAT	Clear Air Turbulence
CDA	Continuous descent approach
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
ENSO	El Niño Southern Oscillation
EPA	United States Environmental Protection Agency
FAR	First Assessment Report
FDI	Foreign Direct Investment
FGD	Focus Group Discussion
GCM	General Circulation Models
GDP	Gross Domestic Product
GHG	Greenhouse gas
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICT	Information Communication Technology
IPCC	Intergovernmental Panel on Climate Change
KCAA	Kenya Civil Aviation Authority
MSD	Meteorological Services Department of Zimbabwe
NASA	National Aeronautics and Space Administration
REDD+	United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation
SAA	South African Airways
SADC	Southern African Development Community

SAF	Sustainable aviation fuel
SAF	Sustainable Aviation Fuels
SPSS	Statistical Package for the Social Sciences
SSA	Sub-Sharan Africa
TAR	Third Assessment Report
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCC	United Nations Framework Convention on Climate Change
UNWTO	World Tourism Organization
WEF	World Economic Forum
WMO	World Meteorological Organization
WRI	World Resources Institute
WTTC	World Travel & Tourism Council
WTTC	World Travel & Tourism Council
ZimAsset	Zimbabwe Agenda for Sustainable Socio-Economic Transformation
ZIMSTAT	Zimbabwe National Statistics Agency
ZMD	The Zambia Meteorological Department

Chapter 1: Introduction and Background of the Study

1.1 Introduction

Tourism is a crucial sector in the development of many countries in Africa. It is an essential tool for addressing the persistent challenge presented by the triple nexus of poverty, inequality and unemployment across the world (Matiza and Oni, 2014). Its pre-eminence emanates from the potential to catapult the poor into wealth creation through the employment of skilled and semi-skilled labour force (WTTC, 2013a). The tourism industry is labour intensive and employs an average of one in nine of the global workforce (Scowsill, 2015). This figure is, however, still small in Africa, which has an enormous tourism potential as the average is still 1 in 14 (WTTC, 2013a). Muchapondwa and Pimhidzai (2011) as well as Hernandez and Ryan (2011), noted that tourism is a multi-trillion dollar economy that contributes to foreign currency generation and plays a significant role in the employment of many youth and women. It remains one of the fastest growing industries in the world with an average growth rate higher than most industries (Budeanu, 2005). Furthermore, tourism fosters growth with equity benefiting the most marginalised and impoverished communities (World Bank, 2006).

In Zimbabwe, tourism has gone through various episodes of highs and lows both pre and post-independence in 1980 (Zhou, 2013). Its significance, however, has always been pivotal in driving the Zimbabwean economy. For some years, tourism has been the second highest contributor to the Gross Domestic Product (GDP) of Zimbabwe's export with a share of US$ 506,8 million of commercial services exports in 2015 (WTTC, 2016a). Tourism accounted for 7.3% of the total exports in 1997, before reaching an all-time low in 2003, where it contributed 3.3% of total exports (Christie and Crompton, 2001). However, as of 2015, the industry had grown and contributed 11% of the GDP (18.8% of total exports) with a value of $506 million (WTTC, 2016a). During the same period, the industry employed about 7.3% of the total labour force in the country. In 2015, Zimbabwe received an estimated 1,851,000 visitors a phenomenon that contributed towards the much-needed foreign currency and foreign direct investment -FDI (WTTC, 2016a).

The Zimbabwean tourism sector is primarily modelled around the principles of pro-poor and Fair-Trade Tourism, which fosters economic growth with equity ensuring that local communities benefit from tourism development. As such any alterations in the tourism market will not only have an impact on tour operators but also have far-reaching consequences on host communities. According to Mashinya (2007), the Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) program which is the flagship of pro-poor tourism in Zimbabwe and southern Africa was designed to ensure that local people benefit from ecotourism to reduce poverty, create employment and infrastructure development. The ecotourism sector in Zimbabwe was worth US$143.5 million with US$15.8 million coming from safari hunting in 2007 (The Heinz Center, 2012). Frost and Bond (2007), noted that by 2011 tourism revenue in the country totalled US$634 million of which US$20 million came from Safari hunting. Any changes, therefore, that could threaten this crucial economic sector like climate change will have a far-reaching impact on tourism and the local community who benefits from the tourism industry through the CAMPFIRE.

Tourism is a sensitive climate industry that requires specific weather parameters in most destinations (Martin, 2005). Evidence from several case studies globally shows that climate change will lead to revenue losses in certain destination resorts. The United Nations World Tourism Organisation - UNWTO (2007), noted that the threat of climate change is a present and real problem that needs to be studied to examine the extent of the risk and possible benefits. Climate change-related extreme events such as increased occurrence and severity of storms, flooding, fires and aridity to mention a few disturbs tourism resorts, activities and infrastructure in Africa and elsewhere (IPCC, 2007). The adverse impact of climate change witnessed and anticipated is a big worry from an environmental, social and economic perspective whose effect will be felt by the tourism industry. The World Economic Forum - WEF (2014), argued that water crisis, climate-related challenges and increased the occurrence of harsh climatic events which ranges from severe floods to intense cyclones and severe droughts as the number three, four, five and six world risks respectively to watch out for in the year 2014. A report by the Intergovernmental Panel on Climate Change (IPCC) paints a dire picture of the global village due to climate change (Christensen et al., 2013). Everyone and all sectors of

people's daily lives are increasingly under threat from extreme weather events caused by anthropogenic climate change. To this end, the threat of climate change is hard to ignore given the significance of the tourism economy to Zimbabwe. There is, therefore, need to ascertain how climate change is going to affect local dynamics of tourism in Zimbabwe and tourism resort towns such as the Victoria Falls.

Regardless of this potential to transform the local economic dynamics to Zimbabwe, tourism is both a negative and a positive when it comes to climate change. Tourism activities within the value chain are resulting in the huge carbon footprint that leads to global warming and consequently climate change (Luo et al., 2018). Climate change is anticipated to have serious negative implications for the Victoria Falls resort. As such tourism is both threatened and is a threat to climate change in the main (Dube, 2016).

Given the pressure exerted by global warming, there is a growing interest in the study of tourism's contribution to GHG emission. Few studies have been carried out in some parts of the world in this regard (Beckan and Hay, 2012). Academics are working to establish the complex relationship between tourism and climate change (Otto and Heath, 2010). Other studies to ascertain the carbon footprint of tourism include those for mega-events such as the 2010 World Cup in South Africa, Davos and New Zealand's transport emissions to mention a few (Otto and Heath, 2010; Beckan and Hay, 2012). The increase in such studies points to the growing demand for sustainability of the tourism industry in relation to climate change. Such studies have revealed that tourism resorts have a larger and growing carbon footprint in comparison with local standards.

The IPCC (2014), noted that tourism contributed about 5% of the total GHG emissions throughout the value chain. In this value chain, the transport sector accounts for the bulk of the emissions accounting for 75% followed by the accommodation sector at 21% and 4% coming from the activities (WTO, UNEP, WMO,2008). Gossling and Peeters (2015) and Friedlingstein et al. (2014), postulates that emission levels from tourism will continue to grow to reach a peak of 130% in 2035 as the industry expands. The GHG emissions are the main drivers of global warming and consequent climate change. Hence there is a need to map and understand these to minimise the carbon footprint to offset dangerous

climate change within the tourism value chain. The tourism industry has to curtail the emission levels in line with the Paris Agreement on climate change through transparency in reporting and monitoring (Scott et al., 2016a).

1.2 Problem Statement

Tourism is very sensitive to climate change, and one of the main drivers of climate change is the increase in carbon emissions (Michailidou et al., 2016). The tourism sector is both a culprit and a victim of climate change, and as indicated earlier the sector contributes 5% of total global carbon emissions. There are conflicting scenario outcomes on the impact of climate change on tourism depending on the geographic location of the destination. Some destinations are expected to gain from the climate change phenomenon whereas others will be net losers (Hall, 2008). However, a review of current literature points to wide locally specific knowledge gaps. Hoogendoorn and Fitchett (2016c) and also Scott et al. (2016a) underscored the need for more focused research on both impact assessment of tourism on climate change and the impact of climate change on tourism in line with demands of the Paris Agreement on climate change. Addressing these knowledge gaps will go a long way in providing a better understanding of the complex relationship between climate change and tourism and vice versa to build mitigation and adaptation capabilities. A climate compatible tourism sector in general, and Victoria Falls specifically, is what this work seeks to make a significant contribution towards.

Regardless of the seemingly glorious picture shown here the tourism sector in Zimbabwe is under severe threat from climate change related extreme weather events such as droughts, flooding, wildfires and extreme snow (Chanza, 2018). On the other hand, tourism ventures in the country also adversely contribute to climate change through greenhouse gas (GHG) emissions. Although there is some evidence suggesting that the tourism industry in Zimbabwe will be affected by climate change, it seems this matter is under-researched. To the author's knowledge, and based on the extensive literature review undertaken there are no known studies that indicate how tourism in Zimbabwe, in general, and in Victoria Falls specifically is being and or going to be affected by the current

wave of extreme weather events. It is also unknown how the industry affects climate change incidences such as the anticipated 2 °C global average temperature increase, increased droughts and 20% reduction in annual precipitation as observed by Conway et al. (2015). It is therefore imperative investigating the link between climate change and tourism to ascertain response capacity and strategies by business and tourists to extreme weather events as these are also not known. This is despite evidence from other countries that are reliant on ecotourism like Zimbabwe that points to serious negative ramifications of climate change on tourism (Hoogendoorn and Rogerson, 2016; Hoogendoorn and Fitchett, 2016).

1.3 Rationale

Given the significance of climate change threat at the global level, extensive research has been conducted to quantify its impact on people's lives. The subject of climate change is however widely under-researched in Africa and Zimbabwe, with many knowledge gaps still existing in various geographic areas and sectoral spheres (Hall, 2008; Rogerson, 2016; Scott et al., 2016b). Gossling (2010), indicated that even though tourism was quite sensitive to climate change, the research on the relationship between climate change and tourism was not covered by the IPCC in its first, second and third assessment reports published in 1990, 1995 and 2001 respectively. Confirming the importance, sensitivity and contribution of the tourism sector to climate change the UNWTO, and its stakeholders held two crucial conferences to tackle the issue of climate change in 2003 and 2007 which led to the Davos Declaration on carbon emissions. The UNWTO (2007), encourage targeted, multidisciplinary research on the impacts of tourism on climate change to address regional knowledge gaps, develop tools for risk assessment and cost-benefit analysis with which to gauge the feasibility of various responses. In support of the previously mentioned findings Boko et al. (2007), highlighted several areas where confidence levels are either low or unknown and indicated ten areas of research priority including tourism. The IPCC (2007:459) stated that:

> 'There is a need to strengthen practical research regarding the vulnerability and impacts of climate change on tourism, as tourism is one of the most outstanding

and highly promising economic activities in Africa. Large gaps appear to exist in research on the impacts of climate variability and change on tourism and related matters, such as the consequences of climate change on coral reefs and how these impacts might affect ecotourism.'

Since the turn of the century, the issue of climate change has become a topical global political agenda (Pang et al., 2013). This can be attributed to pressure and threat posed by extreme weather events that have taken place recently. This pressure culminated in the Paris (Climate Change) Agreement signed by 196 countries in 2015. In the run-up to the Paris Agreement, there was an acknowledgement by the tourism industry on the lack of progress in the sector to meet and monitor earlier targets made at the Davos Declaration on reducing carbon emissions (Scott et al., 2016a). Most importantly there was an admission of the need to do more to reduce the industry's carbon footprint to align the sector with the 2ºC IPCC scenario. The WTTC, therefore, set a 2020 and 2035 ambitious plan of drastically reducing GHG emissions by 50% based on 2005 levels (WTTC, 2015). Scott et al. (2016), reiterate the need for the tourism industry to take stock of the sector and enhance research into its activities with the aim of reducing its carbon footprint. The tourism industry's carbon footprint is set to increase with industry expansion contrary to claims by the WTTC that carbon emission for the sector will decrease in its 2015 report. Friedlingstein et al. (2014), postulated that projected emissions from the tourism sector would triple and grow by 130% by 2035 from 2005 levels and to call on the tourism sector to exchange notes with researchers to curtail dangerous climate change.

On the other hand, the WEF (2016a), noted that climate change was the most impactful disaster over a ten-year horizon. The WTTC (2015:4), acknowledged the sensitivity of the tourism industry to climate change and rendered its support to efforts "aimed at evaluating the physical, regulatory and market risks associated with climate change and its impact to equate emission reduction efforts with associated risks." Scott et al. (2016b), reiterated the calls by Hulme (2016) and also Gossling et al. (2013), on the need for the tourism sector to strengthen mitigation and adaptation research in the tourism industry. Scott et al. (2016c), encouraged tourism industry to surpass modelling and forecasting emissions and go beyond and conduct more research on vulnerability assessments. Core

to their call was a need for the research community to respond to global knowledge disparities in the spatial distribution of tourism and climate change research knowledge in geographic areas that have not been covered by previous research work with Africa seriously lagging behind in this regard (Scott et al. 2015).

The IPCC 5th Assessment Report affirmed earlier findings by researchers (see for example) Boko et al. (2007); Amelung et al. (2008); Hall, (2008) and also Weaver (2011) for more research to cover the knowledge gaps in tourism and climate change in Africa. Although there has been an increase in literature in other regions such as Asia, there is a call for tourism specific studies in Africa. The recommendation for increased focus on understanding possible impacts of climate change and vulnerabilities of the tourism industry as a panacea for achieving sustainable development (Su and Hall, 2014; Rogerson, 2016; Ziervogel et al., 2014). Although tourism is a victim and a vector, it is a significant issue with policy and practical implications for the private and public sector (Ruhanen and Shakeela, 2012).

1.4 Aim and Objectives

This research is broadly aimed at investigating the crucial and complex two-way linkages between tourism and climate change using the iconic and world heritage site of the Victoria Falls resort in Zimbabwe. The following objectives are therefore spelt out:

1. To map out sources of GHG emissions in the Victoria Falls resort tourism value chain and establish ways of mitigating these carbon emissions.
2. To determine evidence of the impacts of extreme weather events on the Victoria Falls tourism and potential intervention measures thereof.
3. To establish perceptions and attitudes on the impacts of climate change on Victoria Falls and vice versa and possible intervention measures for the future sustainability of the attraction.

1.5 Research Questions

1. What are the sources of GHG emissions within the Victoria Falls resort value chain and what appropriate mitigation measures are available to reduce such carbon emissions?
2. What evidence of extreme climate change-related weather events exists in the Victoria Falls resort and which appropriate intervention measures could be put in place?
3. Which perceptions and attitudes on the impact of the impact of climate change on tourism and vice versa are prevalent and what possible intervention measures can be instituted?

1.6 Contribution of the Study

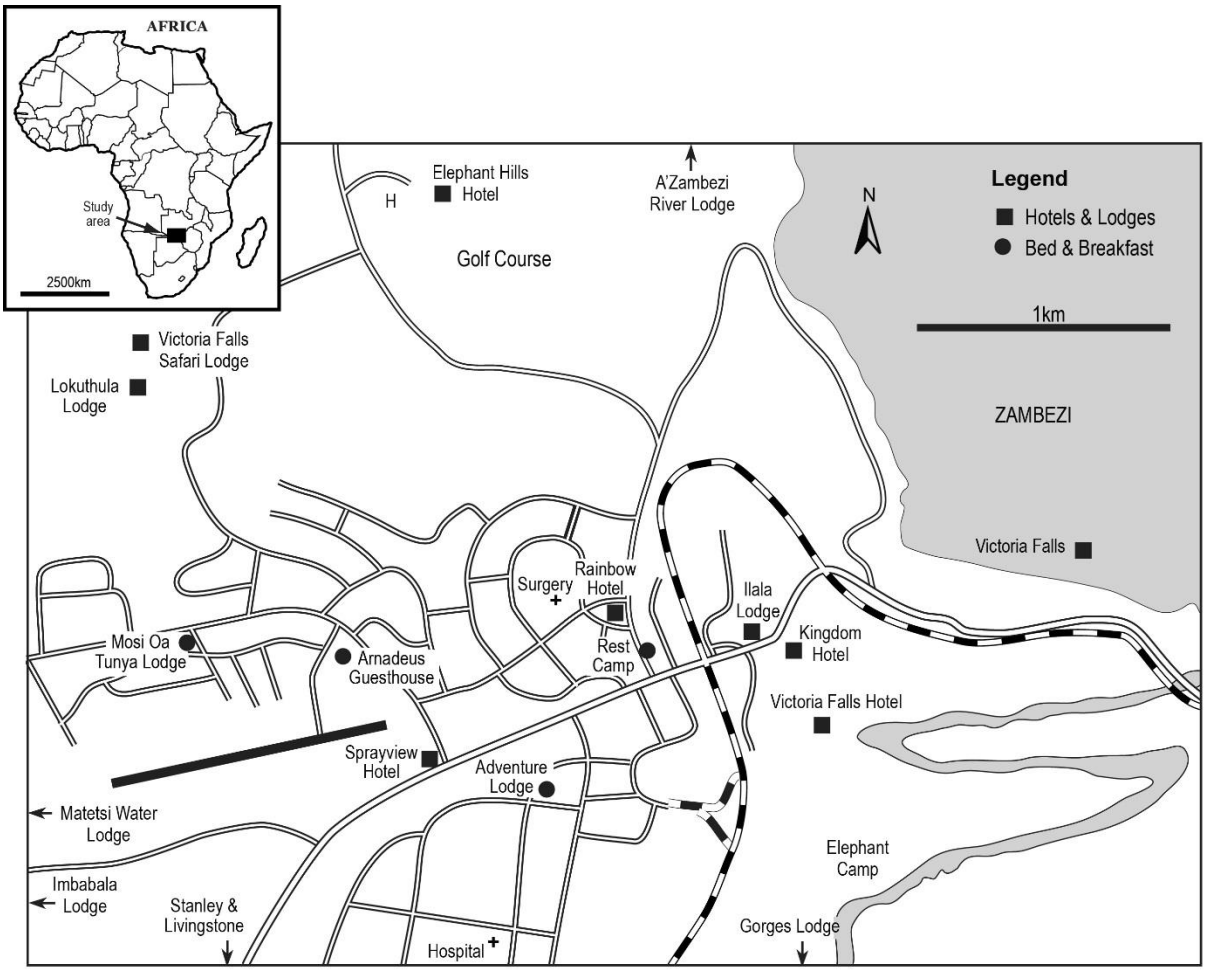
Climate change in tourism is as much an environmental, as it is a socio-political and economic feature that affects people's daily lives. The understanding of the intricate two-way link between climate change and tourism is essential as it has implications for business and people's lives. The view that climate change is a social construct which affects livelihoods and tourism, in general, is little understood in Zimbabwe and Victoria Falls in particular. Climate change is about people and how they live. Therefore the understanding of environmental, socio-political and economic impacts and evidence of climate change is crucial to this research. There is a growing worry amongst tourism players in Zimbabwe and abroad for climate knowledge on the two-way linkages between climate change and tourism. Academics, researchers, tourists and other role players have expressed concern over the growing impact of climate change in journal articles, newspapers and social media platforms on the resort with demand for expanded knowledge. This research is a response to national, regional and global demand for knowledge on the subject.

1.7 Study Area

The location of the study area is shown in Figure 1.1 Victoria Falls lies on the Western border tip of Zimbabwe in Matebeleland North Province and South of Zambia. Shared by

the two countries, it is located some 441km North West of Bulawayo in Zimbabwe at the border of Zimbabwe and Zambia. The resort is accessible by road, air and rail within Zimbabwe and Zambia and by air from many regional ports. The Victoria Falls is ranked amongst the Seven Wonders of the World, and the site remains wrongly marketed as having been discovered by the Scottish Missionary, Dr David Livingstone on 16 November 1855.

Figure 1.0:1: The Geographic Location of Victoria Falls Zimbabwe



Source: Dube and Nhamo (2018:5a)

The Victoria Falls is part of the Victoria Falls National Park in Zimbabwe and is an estimated less than 100km from the Hwange National Park, also in Zimbabwe. The Zambezi National Parks and Victoria Falls plays host to the Victoria Falls. Other attractions within reach on the Zimbabwean side include the Hwange National Parks and

Chobe National Parks in Botswana. With over 30 activities to do throughout the year listed on TripAdvisor Victoria Falls is the most visited resort in Zambia and Zimbabwe. The resort is home to some adventure activities ranging from adrenaline and action activities, wildlife and safari adventures, and scenic tours to cultural events. The most popular activities include but are not limited to the following; rainforest trail walks, elephant back safaris, white water rafting, heritage tours, game drives, cruises, helicopter flights, bungee jumping and cultural tours among others.

The Victoria Falls is further touted as Africa's paradise because of its beauty. As indicated earlier, the Victoria Falls is a UNESCO World Heritage Site and was inscribed in 1989 having been nominated in 1988. It also Ramsar site and as such its categorised as a wetland. The area around Victoria Falls has rich and diverse biodiversity which includes birds, animals and a variety of water animals. Being a water-dependent site, the resort is vulnerable to droughts and other human developments projects including tourism. This makes it particularly vulnerable to climate change like the larger part of southern Africa which is set to become hotter and drier as a consequent.

Victoria Falls received 544.104 tourists in 2015, and the figure is set to be way higher than this in 2018 (UNESCO, 2016). In 2017 air pollution, drought, housing, water abstraction and tourism-related activities were cited as some of the significant threats to the World Heritage Site property. Victoria Falls is found along the Zambezi River which one of the fourth largest rivers in Africa and is expected to witness reduced water flow as a consequence of climate change which will potentially affect economic activities along the river (Beck & Bernauer, 2011). Climate change is expected to disrupt some of the major economic activities along this significant river which includes tourism, agriculture and electricity production to mention a few. Hall and Higham (2005), predicted that climate change would see a 2°C increase in the Zambezi basin by 2050 in summer months. This will result in a 25% increase in evaporation rates at a backdrop of 15% drop in rainfall amount resulting in 40% decline in runoff which will affect all the basin tourist attractions

1.8 Thesis Outline

The thesis is divided into 7 Chapters outlined as follows: Chapter One comprises of the introduction chapter. The introductory chapter provides a comprehensive background on the two-way relationship between climate change and tourism. Chapter Two covers a broad spectrum of a literature review on concepts, theories and contextualization of the research highlighting existing knowledge practices and gaps on the issue of climate change. Chapter Three present the methodological research approach in theory and practice as applied to this research. Chapter four, five, six and seven comprise of research findings with each research question's findings presented as a separate chapter. Chapter eight is the final chapter consisting of a summary of findings, conclusion, suggestions for future research.

Chapter 2 : Literature Review

2.1 Introduction

This chapter covers a broad spectrum of concepts, theories and contextualization of the research highlighting existing knowledge practices and gaps in the two-way relationship between the impact of climate change on tourism and vice versa. The chapter explores the issue of climate change first starting with the general issues and narrowing down to its relationship to the general world economy. This will be followed by a section that looks at climate change and the environment as well as, climate change and tourism from a global perspective, to the continental, regional and local levels. As indicated earlier during the process, a two-way relationship between climate change and tourism will be examined.

2.2 Tourism and the global economy

Tourism is undoubtedly one of the biggest and significant economic sectors in the world that contribute to the development of both developing and developed economies and the sector has been growing rapidly since 1950 (Shahzad et al., 2017). Tourism is favoured as an essential part of a socio-economic development that fosters employment creation and enterprises, export revenue generation and infrastructural development globally (United Nations World Tourism Organisation - UNWTO, 2016). In 2011 the tourism sector passed the one billion visitor mark, contributing more than US$1.1 trillion in revenue (World Bank, 2016a; World Bank, 2016b).

The World Travel and Tourism Council - WTTC (2016), pointed out that the tourism economy continued on its growth path trajectory in 2015 regardless of the challenges it faced such terrorism, disease outbreaks like Ebola, and other natural disasters. The tourism sector grew by 3.1% higher than the global average economic growth rate and created employment for 284 million global citizens (1 in 11 jobs) in 2015. This contributed US$7.2 trillion translating into 9.8% of the world Gross Domestic Product – GDP (WTTC), 2016).

Given the increase in the tourism product demand globally, tourism creates unique opportunities for people who are employed in this sector (Medina-Muñoz et al., 2016). It is widely credited with creating jobs for the most vulnerable people in communities such as youth, women, immigrants and semi-skilled employees (WTTC, 2016a). As a consequent, the tourism industry practitioners credit it for assisting in reducing unemployment and reducing poverty especially in developing countries (Saayman et al., 2012).

2.3 African and Zimbabwean Tourism Economy

Tourism has been doing well in the African region although it is lagging behind other global regions on arrivals and economic performance. This is evident when taking into consideration the size of the continent and the natural capital base it holds. The tourism sector contends with many challenges that hinder growth which includes poor policy framework, lack of proper infrastructure, disease outbreaks, political instability, poor safety and security record (World Economic Forum - WEF, 2015; United Nations World Tourism Organization - UNWTO, 2016). In 2015, the region created about 21,6 million jobs. The figure represents 7.2% of the total employment figures which is 2.1% lower than the global average of 9.5%. During the same period, the total GDP contribution from tourism was $180 billion, representing 8.1% of total GDP (WTTC, 2016b). Tourism in Africa is expected to continue on an upward growth path trajectory.

Zimbabwe has a diverse tourism industry that is buttressed by substantial natural resource capital and a rich heritage, which act as a tourist drawcard (Muchapondwa and Pimhidzai, 2011). The country lies between Zambezi River to the north and Limpopo river to the south. It boasts of five World Heritage sites falling in the cultural and natural category as illustrated in Table 2.1 (United Nations Education Education, Scientific Cultural Organization - UNESCO, 2016).

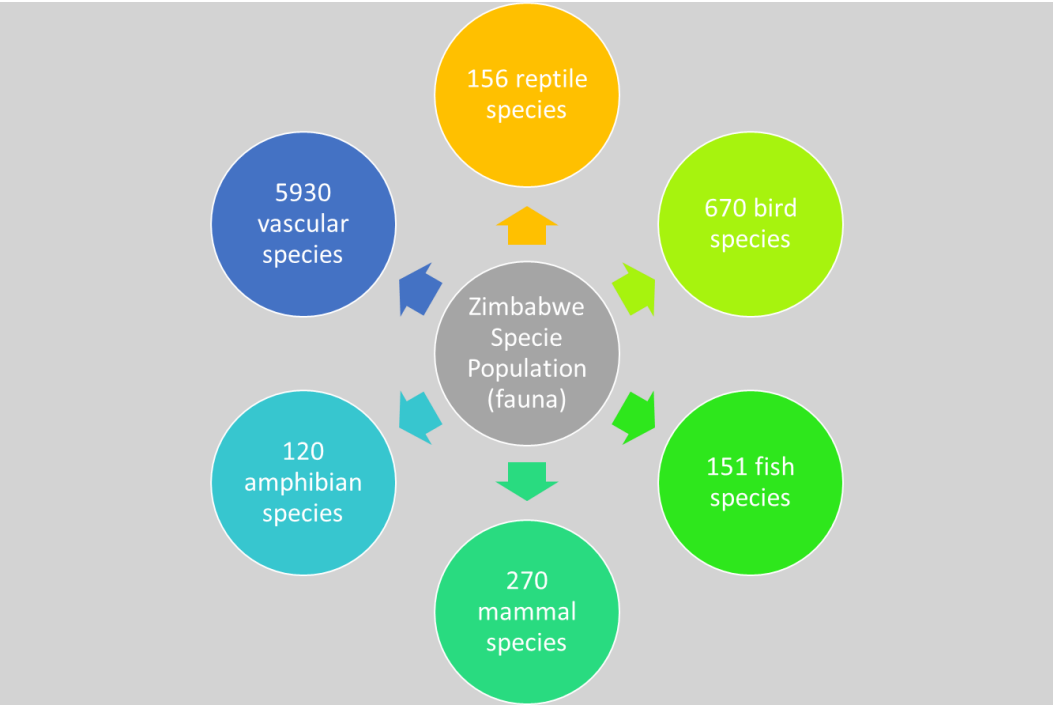
Table 2.1: World Heritage Sites in Zimbabwe

Name of Heritage Site	Category	Location
Mana Pools National Park, Sapi and Chewore Safari Areas (1984)	Natural	Northern Zimbabwe (near the border with Zambia)
Khami Ruins National Monument (1986)	Cultural	South Central West of Zimbabwe
Great Zimbabwe National Monument (1986)	Cultural	South Central East of Zimbabwe
Mosi-oa-Tunya (Victoria Falls) (1989)	Natural	Western Zimbabwe
Matobo Hills (2003)	Cultural	South West Zimbabwe

Source: Author's Compilation

Zimbabwe boasts of vast biodiversity of flora and fauna including the world's big five which makes it a must visit tourist destination (Muchapondwa and Pimhidzai, 2011). The Ministry of Environment, Water and Climate in Zimbabwe noted that the country took conservation seriously. Since conservation is an important aspect, 26,6 % of its terrestrial and marine resources were considered protected areas as of 2014 (Green Growth, 2017*).* The bulk of Zimbabwe's flora and fauna is found in protected areas and has a variety of species as shown in Figure 2.1. Due to reliance on environmental factors for tourism, Zimbabwe is vulnerable to natural disasters that affect the environment such as climate change and climate variability.

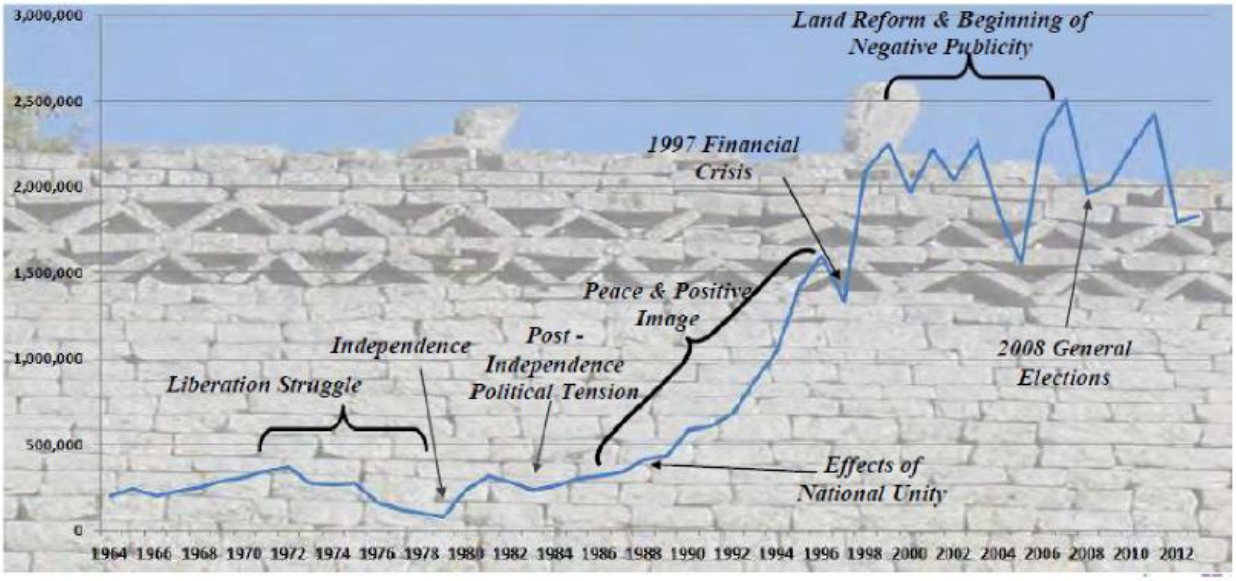
Figure 2:1: Zimbabwe Species Biodiversity as of 2013



Source: Author's Compilation Adapted from (Ministry of Environment, Water and Climate, 2013)

Tourism has been growing in leaps and bounces since the Unilateral Declaration of Independence in 1965 by the Rhodesian government (Rusike and Chitambara, 2012). The sector has been resilient in withstanding the several shocks as depicted in Figure 2.2. Most of the challenges that have been faced by the sector have to do with the policy and regulatory framework of the country. The tourism industry is a strategic sector in Zimbabwe that contributes towards economic empowerment, job creation, foreign currency generator and a key driver for infrastructure development Karambakuwa et al., 2009). The economic meltdown of 2008 and the prolonged political instability in Zimbabwe since 2000 have negatively affected the Zimbabwean tourism industry and resulted in the loss of revenue and deterioration of infrastructure.

Figure 2:2: Impact of various events on the tourism industry in Zimbabwe 1964-2012

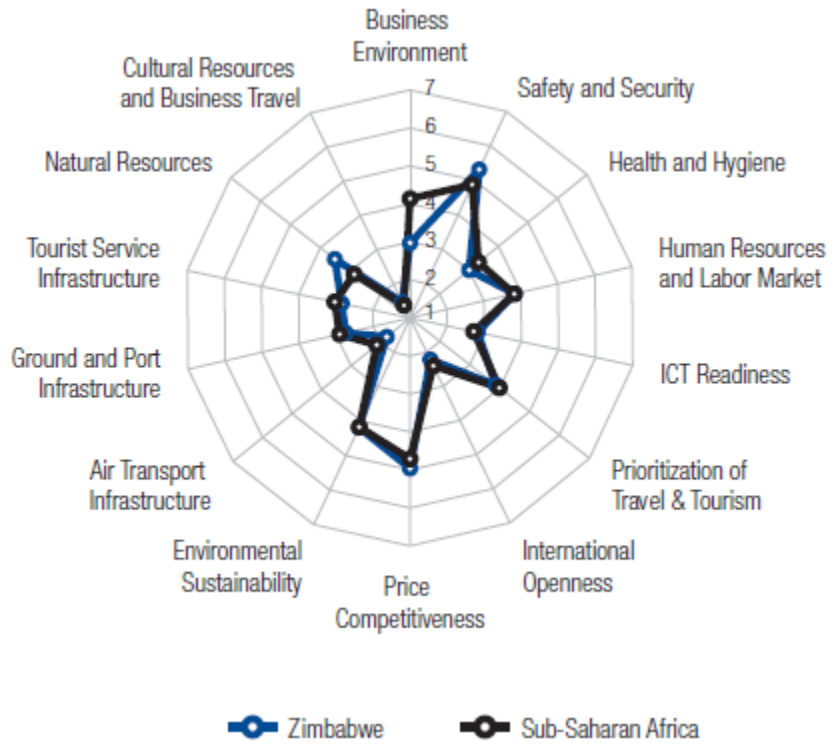


Source: Zimbabwe Tourism Authority (2013:9)

Abel et al. (2013), maintain that tourism in Zimbabwe was strengthened by abundant natural resource, people, culture and history superstructures. However, the sector struggle as a consequent in bad government policy coordination, implementation and often costly policy reversals. Regardless of the industry's economic significance, it is faced with numerous challenges such as inadequate transport infrastructure for both air and road transport. Zimbabwe has poor internal airline connectivity which hampers tourists movement. Also, the sector suffered from inadequate skills and experience mix in tourism facilities, poor domestic tourism promotion, poor service at border posts and ICT usage (Kwanisai et al., 2014).

The WEF (2014), in its global competitiveness report, rated Zimbabwe tourism industry 115 out of 141 with a score rating of 3.09 out of 7. This low score is attributed to the lower ranking that Zimbabwe scores in areas such as ease of doing business, business environment, poor air transport infrastructure and Information Communication Technology (ICT) readiness among other factors. Figure 2.3 depicts various aspects that were rated by the report. However, Zimbabwe scored very high in Safety and Security, Price Competitiveness, Environmental Sustainability and its natural resources where it is scored and positioned high on global and regional tourism players.

Figure 2:3: Zimbabwe's Travel and Tourism Competitiveness Index Score 2015 A Regional Comparison



Source: World Economic Forum (2015:350)

The Zimbabwe tourism sector witnessed a robust growth regarding arrivals in 2015 as it grew by 9%, way over the global tourism growth rate of 4.6% (United Nations World Tourism Organization - UNWTO, 2016). This growth rate was only surpassed by Island states in SADC states such as the Seychelles, Mauritius and Madagascar, which recorded growth rates of 19%,11% and 10% respectively (Ibid). Therefore, in 2015 the tourism sector outperformed most economic activities in the country as it contributed US$1,499 million that equated to 11% of the country's total GDP as shown in Table 2.3. It accounted for 7.3% of total employment by employing 418,000 people (WTTC, 2016c).

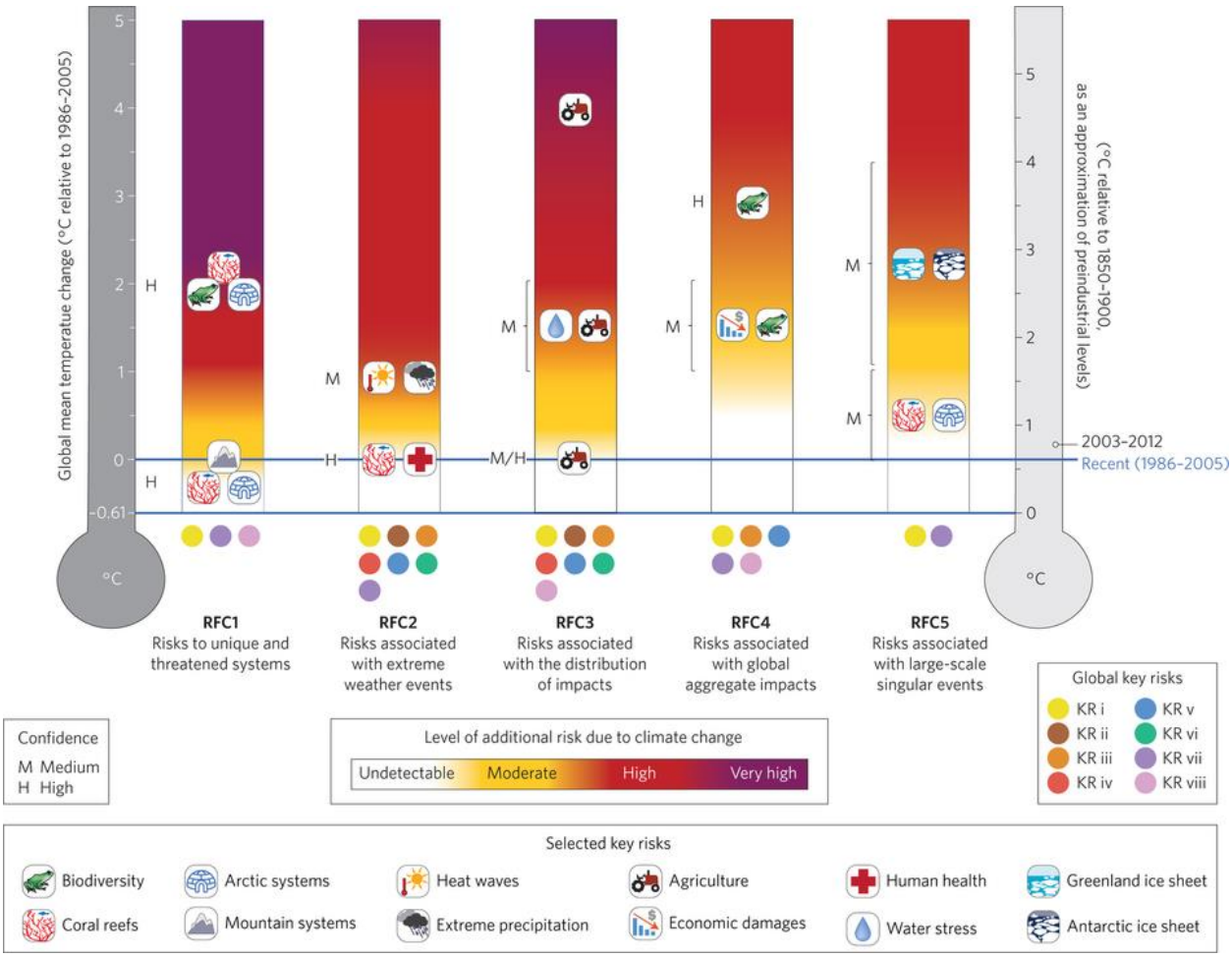
2.4 The Science of Climate Change

One of the most significant challenges that are extensively studied across various fields of today's world is climate change. The climate, in general, refers to average weather conditions over an extended period for a given area (Davis, 2011). Houghton (2002:3),

gave a similar definition but further explained that climate is “the average state statistics for a particular time scale including all deviations from the mean obtained from the ensemble of conditions recorded for many occurrences for the specified period.” However, of growing interest is the subject of climate change. Allwood et al. (2014), defines climate change as changes in climate over and above the natural climate variability that are attributed directly or indirectly to human activities measured over a given period.

Human civilisation and related activities release carbon dioxide and other greenhouse gases (GHGs) into the atmosphere. Industrial and various tourism activities result in the burning of fossil fuels, release harmful carbon dioxide into the air which leads to the trapping of heat into the lower atmosphere (Lu and Wang, 2018). As economies and global population growth, the pressure is put on resources that result in activities that lead to the release of GHGs such as methane, carbon dioxide, nitrous oxide, ozone and water vapour (Szulejko et al., 2016). An increase GHG emissions leads to an increase in global temperature a process known as global warming. Global warming is a key driver of climate change. Climate models predict that global temperatures will continue to grow well into the future with far-reaching effect on life as we know it. O’Neill et al. (2016), outlined some of the major global risks that are posed by climate change going forward and their level of threat as signified In Figure 2.4.

Figure 2:4: Global Risks posed by Climate Change as a factor of global warming



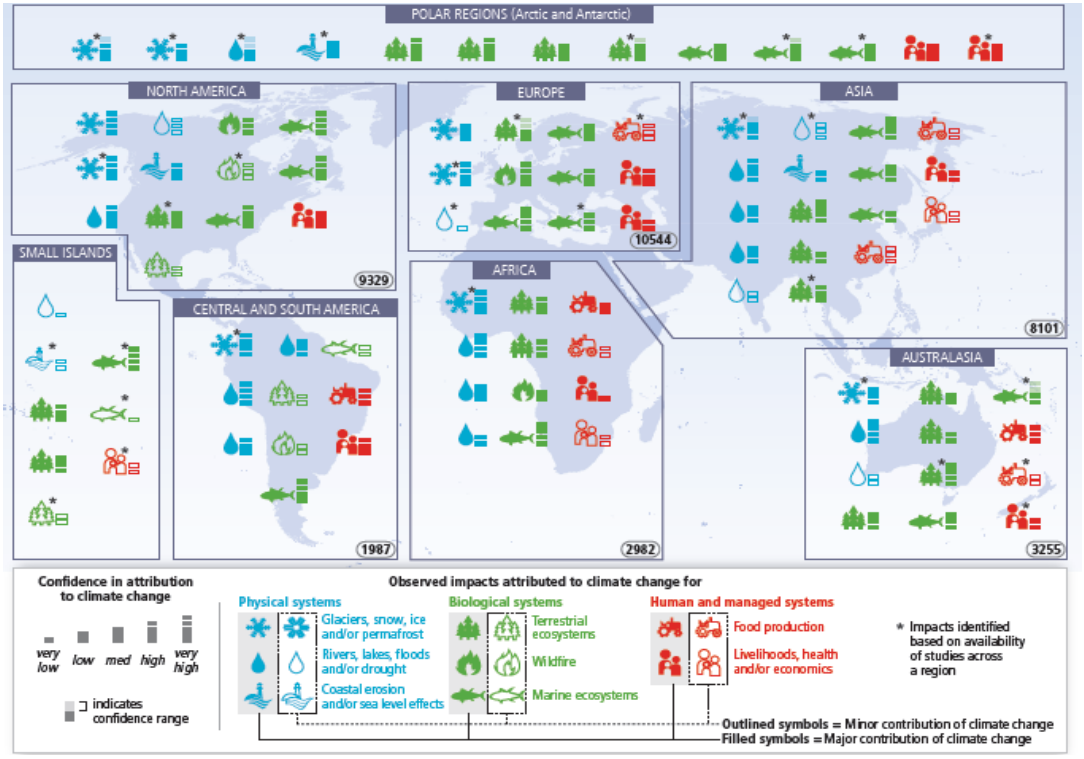
Source: O'Neill et al. (2016:30)

Climate scientists have drawn a correlation between rising global temperature and rising sea level that has led to inundation of some parts of small island states and some coastal areas of the world (Isobe, 2013). Rising sea level is a consequent of oceanic thermal expansion with some scientists indicating that polar ice melting is also a contributing factor to this worrying challenge (NASA, 2016). Rising sea level will prove problematic to many infrastructure developments along coastal areas and will cost many states billions of dollars and will impact negatively on tourism. One of the detrimental effects of rising sea level is that it will result in coastal flooding and human activity disturbances causing havoc in low-lying coastal areas through inundation and flooding (Isobe, 2013). Climate

change will have severe negative impacts on water-based tourism resorts especially those along coastal areas (Grenfell et al., 2016).

Climate change affects and will affect various geographic regions differently at a macro and micro-scale. The 5th Assessment Report (AR5) noted the available literature shows that different parts of the world will be impacted differently (Intergovernmental Panel on Climate Change - IPCC, 2015). Figure 2.5 illustrates how climate change will affect different geographic regions of the world in the main. The map, however, is a generalised picture based on accepted peer-reviewed scientific findings that give us a rough idea of how climate change will affect various geographic regions at a macro scale. The impact of climate change differs from place to place.

Figure 2:5: Widespread impacts attributed to climate change on scientific literature as of July 2011.



Source: IPCC (2015:7)

Figure 2.5 indicates that climate change will chiefly affect biological systems and physical systems and the confidence levels for the scientific basis for that is on average high for most geographic regions in the world. While there is an appreciation that climate change

will affect human and management systems confidence levels are medium to low on average for most geographic regions (IPCC, 2015).

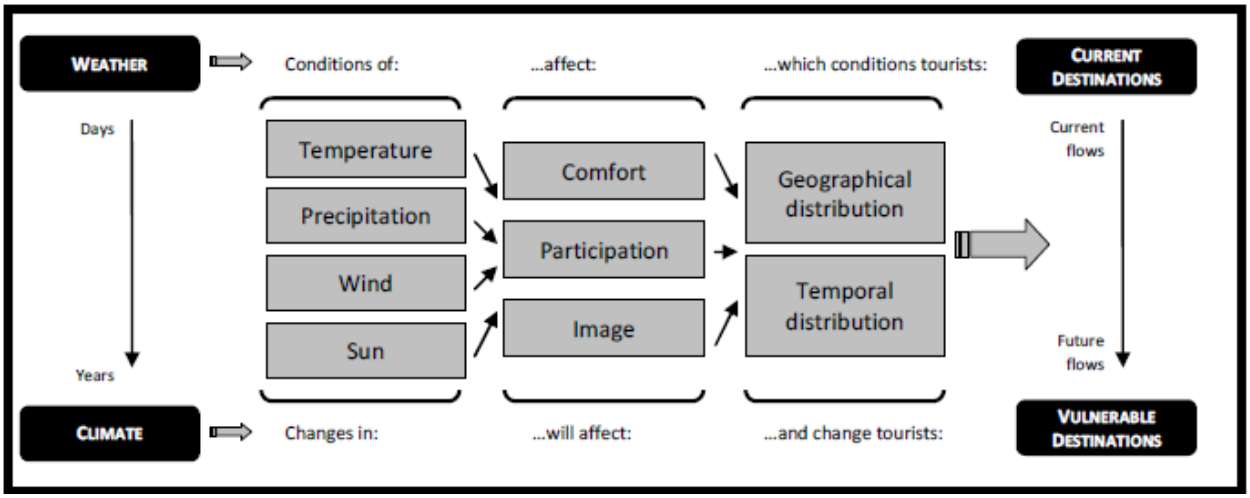
2.7 Weather, Climate, Climate Change and Tourism

The climate is a significant factor in human civilisation, and its study has been in existence since 340BC as it determines development success and failure (Diamond, 2005). The significance of climate to human civilisation manifested in the development of sophisticated technology such as radar, satellites, communications which significantly improved climate modelling, forecasting and archiving to inform human activities. The climate in tourism is both a resource and a constraint as it shapes tourism activities and also acts as a standalone resource (Martin, 2005). As such, climate factors significantly shape and influence tourists physically, physiologically and psychologically. Tourists choices are greatly influenced by perceived climatic conditions of an area. As such climatic factors of a tourist resort have a significant impact on destination image and tourism marketing and tourist's experience (Li et al.,2017). The other aspects of climate such as thermal and physical components are essential for tourism infrastructure design and are fundamental in determining operating costs (Gössling, et al., 2012).

Climate and weather are critical to the development and success of a tourism resort as they are essential in the decision-making process of a tourist. Li et al. (2017), noted that climate is one of the main driving forces for tourism and a critical tourist resort attribute that either facilitates enjoyment of activities or the main resource of a particular destination. Among other factors, international tourism seasonality in many destination areas is a factor of climate as climate determines the time of travel by tourists (Hamilton and Lau, 2005). Tourism players, planners and academics have over the years been engaged in developing models that assess weather and climate suitability of various resorts which led to the development of Tourism Climate Indexes. The most famous were drawn up by Mieczkowski in 1985 confirming the importance of weather and climate in tourism. The model was aimed at evaluating resorts by assessing climatic factors such as temperature, humidity, precipitation and wind velocity (Mieczkowski, 1985).

The experience by tourists in certain settings such as national parks and other outdoor activities is a factor of prevailing climate. Drought years tend to affect biodiversity and flora and fauna. One of the integral components of the debate of weather, climate and tourism is its impact on the safety and mobility of tourists. Extreme weather events such as hurricanes, heavy snowfalls, flooding and severe droughts act as a deterrent to tourists and tour operators as it destroys the infrastructure that tourism is dependent on (Martı´n, 2005). Transport network systems are all vulnerable to the vagaries and swings of weather and climate (Cegnar, 2016). Weather incidences can lead to cancellations and postponements of tourists visits. Climate and weather, therefore, are central to the planning and development of tourism. Figure 2.6 illustrates the significance of tourism and climate and their changes to climate change

Figure 2:6: How climate and weather interact with tourism



Source: Adapted from Moreno (2010b:8)

The tourism industry has a strong linkage with an environment which either acts as resorts or support for tourism to occur (Steyn and Spencer, 2012a). The increase in the number of studies that seek to explore the relationship between tourism and climate change is a testament to the significance of weather and climate to the tourism industry. Recent global debates have been focussing on the issue of climate change which threatens biodiversity and environment as we know it with a knock on effect on the socio-economic lives of people (Kibria, 2016; Hambira et al*.,* 2013; Kaja´na and Saarinena, 2013). Studies

indicate that Africa is going to be adversely affected by climate change with the tourism industry expected to bear the brunt (Jenkins and Nicholls, 2010; Richardson and Witkowski, 2010; Hambira et al., 2013; Scott et al., 2016c). One of the threatened environments by climate change is the riverine environment and water bodies. This poses a significant threat to water-dependent attractions in Zimbabwe such as the Victoria Falls, Kariba and others across the country. However, the topic is little understood owing to lack of research around tourism and climate change especially in Africa (Hoogendoorn and Rogerson, 2016b). There is, therefore, a need for more research on climate change and tourism in nature-based tourism destinations such as Zimbabwe, Mozambique, Namibia, Malawi, Swaziland and Lesotho (Hoogendoorn and Rogerson 2016). The next section looks at climate change in Southern Africa and implications for tourism.

2.8 Climate Change in Southern Africa: Implications for tourism

Climate change will severely affect Africa given its low adaptive capacity as a consequent of resource and technical constraints (Hoogendoorn and Fitchett, 2016). It is expected that extreme weather events will witness an increase in a number of heat wave days, high fire danger days' frequency and occurrence is projected to increase over the years (Russo et al*.,* 2016). There are uncertainties with regards to future precipitation patterns as a General Circulation Models (GCM) produce systematic errors when it comes to modelling future climate in Africa. The errors distort temperature, El Nino Southern Oscillation and the African monsoons. However, it is forecasted that climate change will lead to increased evapotranspiration rates and a consequent decrease in soil moisture which will affect humans and wildlife (Jakob, 2010; Joly et al*.,* 2007; Engelbrecht and Engelbrecht, 2015b). Given Africa's dependence on natural stock for a thriving tourism industry, changes will have a grave impact on the tourism and agricultural sector.

Climate change will present a set of challenges for southern Africa mainly, due to an increase in temperature, which has been observed to be higher than that of the rest of the world. An increase of 3.2 °C or more is expected in southern Africa (Bidassey-Manilal et al*.,* 2016). An increase in temperature coupled with an increase in heatwaves, hot days and decreased precipitation will have a significant impact on grass development in the

fragile ecosystems which will negatively affect wildlife (Chadwick, 2016). Any changes in grass or biodiversity have the potential to adversely affect the game ranching and ecotourism industry which has been a strong foreign revenue earner.

The issue of climate change is a serious matter to Africa and Zimbabwe in particular as it is hugely dependent on primary means of production for economic sustenance (Engelbrecht et al., 2012). As a consequence, much of the research has been dedicated to examining the impact of climate change on agricultural productivity and to some extent on hydrological processes given their direct impact on food security (Simba et al., 2012a; Brown et al*.,* 2012; Bank, 2014). Recent findings show that countries such as Zimbabwe are going to experience a precipitation reduction. This will adversely affect the environment and livelihood security (Chadwick, 2016; He and Soden, 2017). About Zimbabwe, these findings confirm earlier studies by Bhatasara (2015), who noted that Zimbabwe's climate had become warmer with temperature having warmed by the dawn of the 21st century.There is evidence that climate has changed and climate variability has increased in frequency and intensity. Simba et al*.* (2012b), postulated that between 1900 and 1993 precipitation in Zimbabwe had declined by 10% representing an average of 1% per decade. Since tourism is largely dependent on certain climatic conditions, there is a suspicion that extreme weather will alter the Tourism Climate Index for the region (Fitchett et al., 2015).

According to Davis (2011) and Eriksen et al*.* (2008), (GCM) point to an increasingly arid southern Africa. Further drying will have grave consequences on water levels In the Zambezi River and consequently at the Victoria Falls waterfalls especially the Zambian side which dries up months in the run-up to the rain season. While this has been described as the norm by most senior (aged) residents, a closer look at discharge levels dating back to 1907 shows a normal trend with a steady decline in discharge levels at Victoria Falls station (Kling et al., 2014; Beilfuss, 2012). Reduced river flow will reduce the aesthetic value of the falls on the Zimbabwean and Zambian side. Although it is more pronounced on the Zambian side there is no evidence to suggest that this will not extend to Zimbabwean side shortly as hydrographs are continually swinging below the long-term mean.

2.9 Impact of Climate Change on Tourism

While the study of the relationship between climate, weather and tourism started way back, the issue of climate change is relatively recent (Dubois et al*.,* 2016). Much focus and early studies on the impacts of climate change on tourism were conducted in the global north (developed) to the exclusion of the global developing south (Saarinen *et al.*, 2012; Hoogendoorn and Fitchett, 2016). Earlier comprehensive studies on tourism and climate change were aimed at understanding the impact of climate change on winter sports, beach resort tourism facilities and sea levels. This is even though the IPCC's Fifth Assessment Working Group II report estimates that Africa is sensitive and one of the most vulnerable regions to climate change. The adaptation costs are pegged between US$20 and 30 billion with the expectation that it will reach $60 billion by 2030 (Kotecha, 2016). This can be attributable to a shortage of funds and doctoral graduates in the field within the continent of Africa. Regardless of the call for expanded research in earlier reports, the citation for regional implications of climate change and tourism declined in AR5 which is concerning given the increased regional and global concern over the subject area (Scott et al., 2016a). Table 2.2 shows the number of citations in the field to demonstrate the extent of a knowledge gap in various parts of the world with Africa citation having decreased in AR5.

Table 2.2: A comparison of tourism content (Citations) in IPCC assessments

	FAR 1990	SAR 1995	TAR[1] 2001	AR4[1] 2007	AR4[2] 2007	AR5 2013–2014
Working Group 2: Impacts, adaptation and vulnerability						
Regional						
Africa			3	28	25	6
Asia			9	7	7	1
Australia and New Zealand			22	31	29	27
Europe			34	40	37	35
Central and South America			10	10	11	10
North America			86	27	22	4
Polar regions			11	7	7	12
Small islands			26	47	48	40
Oceans						42
Regional chapter total			*201*	*197*	*186*	*177*

Adapted from: Scott, Hall and Gössling (2016a: 12)

A list compiled by Hoogendoorn and Fitchett (2016), mirrors the lack of research into the area of climate change and tourism. The list shows that there has been an increase in the investigation of certain thematic areas in countries such as South Africa with eight publications between 2012 and 2016, Botswana five publications, Ghana one, Tunisia with one, Sub- Sahara Africa 1 and no research from Zimbabwe on that, particularly from Victoria Falls. Table 2.3 highlight some of the selected journal publications on tourism and climate change.

Given the significance of the growing tourism industry to sub-Saharan Africa's (SSA) economy, there is a need to conduct more research focussed on understanding the intricate link between tourism and climate change. This must be done in developing mitigation and adaptation for the vulnerable and growing tourism economies (Hamiltona et al*.,* 2005; Hoogendoorn and Rogerson, 2016). Given the fact that tourism is dependent on geographic space that is subject to weather and climate variations research into this topical issue is essential for Southern Africa to ensure industry sustainability (Hall, 2008; Boko et al., 2007). Research into climate change and tourism are paramount as tourism offers a way out of poverty. Poverty is quite endemic in the global south and Sub-Sharan Africa (SSA) in particular (Scott et al., 2015; Rogerson, 2016).

Table 2.3 Selected Work on Climate across Africa

Researcher/ Author	Area Studied	Summary of findings
Parish and Funnel (1999)	Moroccan High Atlas	Climate change will create pressure on valley slopes along the mountain but results in increased tourism revenue opportunities on mountain tops.
Gössling et al. (2006)	Zanzibar Tanzania	Climate is an important aspect in decision making however temperature increase might not have an impact on tourist decision making. Tourists were found not to be aware of their carbon footprint and impact on climate change
Awuor et al. (2008)	Mombasa, Kenya	Climate change will result in coastal flooding that will negatively affect tourism facilities and the economy by proxy

Snoussi et al. (2008)	Mediterranean coast of Morocco	Climate change leads to erosion that will threaten the sustainability of tourism resorts along the coast
Shaaban and Ramzy (2010)	Egypt	Tourism is a sensitive sector to climate change that can also play a meaningful role in mitigation and adaptation to climate change.
Steyn (2012)	South Africa	Climate change will have long-term affect tourism products, distribution and activities and will affect iconic destinations such as Western Cape.
(Hambira et al. (2013)	Botswana, Maun	Indicated the need for sustainable measures to be put in place to deal with the challenges of climate change in the Okavango Delta.
Fitchett et al. (2016a)	St Francis Bay and Cape St Francis, South Africa	Climate change will have serious negative impact on coastal tourism with far-reaching economic consequences
Dillimono and Dickinison (2014)	Nigeria	A noted lack of willingness by tourist to reduce carbon footprint and structural barriers that exist in reducing the carbon footprint of the tourism sector.

Source: Author after Hoogendoorn and Fitchett (2016c:5-6)

Ecotourism is a seasonal business that fluctuates from season to season within a year in most geographic regions. These variations are crucial in shaping tourism firms and activities. Climate change studies indicate that there is a geographic shift in seasons across the world. Due to anthropogenic climate change globally the average length of winter and summer seasons have changed across the world over the past years (Allen and Sheridan, 2015). Kutta and Hubbart (2016), found that winter seasons have reduced in duration by an average of 13 days, whereas summer seasons have increased by about 20 days over the past 36 years. Seasons are crucial for many biological and geological processes that are necessary for flora and fauna to survive (Allstadt et al., 2015). It is not known how such shifts in the season will affect both domestic and international travellers.

Climate change presents a host of challenges for the tourism industry's sensitive sectors. The challenges differ from geographic region to another and from one resort to another. In the polar areas, ice melting will affect winter Olympics (Scott et al., 2015). In coastal

regions and small nation islands, rising sea level is set to inundate tourism resorts and resorts facilities (Fitchett et al., 2016a). Rising sea surface temperatures and acidification will affect the aquatic plants and animals; coral bleaching will drastically affect ocean biodiversity in areas such as the Great Barrier Reef in Australia (Gössling et al*.,* 2012). Increased incidents of extreme droughts will result in loss of biodiversity within national parks and other sensitive ecosystems, which might affect ecotourism activities in those regions. Water-related tourism is also set to be severely affected by climate change as climate models predict hydrological resources in many parts of the world (Wilgen et al., 2016).

Studies conducted in America indicated that extreme temperature and other climate extreme events were on the increase due to climate change. Coffel and Horton (2014), reported that since the 1980s an increase in temperatures during the summer period led to weight restrictions on aircraft in America at certain airports. Weight restrictions were more pronounced in airports with shorter runways due to the threat that was imposed by high temperatures on engine performance. They further noted that in a case study of Boeing 737-800 evidence indicated an increase of weight restrictions of 50%-200% during the summer period by the year 2050. Studies further reveal that Clear Air Turbulence (CAT) have increased by between 10% and 40% owing to climate variability and climate change with the occurrence of median strength frequency increasing by between 40% and 170% (Paul and Manoj, 2013). This growth is paralleled with increased injuries and losses aboard aeroplanes as a consequent of air turbulence (Eick, 2012).

Considering the devastating effect of climate change in which tourism is both a perpetrator and a victim, there is a need for the industry to take stock and accountability for its contribution to the disaster to reducing the carbon footprint. Apart from that, the tourism sector needs to build mitigation and adaptation strategies in the wake of potential losses arising as a consequent of anthropogenic climate change. The IPCC's AR5 challenges all the sectors to substantially reduce their carbon footprint to zero by the year 2100 to avoid dangerous climate change especially in eco-sensitive regions (Scott *et al.,* 2015b). Australasia seems to be the only area that is advanced regarding knowledge capacity for anthropogenic climate change relating to the understanding of climate

change impacts, the level of awareness and concern of tourism stakeholders and limits of adaptation (Reisinger et al., 2014). There is a need to reduce GHG emissions to the required targets to reduce climate change impact to lower the cost of failure to adapt in the long run (Gössling et al*.,* 2015). It is hoped that the 2015 Paris Agreement will set the tourism industry on the correct trajectory for adaptation, mitigation and transparency on GHG emission within the tourism sector.

Increased consciousness and awareness of global warming and its ramifications have led to some research initiatives and several case studies have been conducted in Europe and Australasia(Otto and Heath, 2009). However, it is not known how climate change will affect the local dynamics of the tourism business in Africa. This is worrying given that tourism is a significant economic player in Africa that employs millions of skilled and semi-skilled personnel while providing entrepreneurship opportunities to thousands of small and medium businesses (Hall, 2008 and Boko et al*.,* 2007).

As aforementioned, in Zimbabwe tourism is a beacon of hope for the economy that has gone through severe challenges since the 2000s. Many initiatives are underway to revive the warning tourism industry through intensive marketing, lobbying and infrastructure development such as the construction of the main roads and upgrading of the iconic resort town of Victoria Falls airport. This is in a bid to capture the quick and big wins offered by tourism such as forex revenue and employment. As tourism is expected to grow in Zimbabwe, so is the carbon footprint from tourism activities in the sensitive climate resorts like the Victoria Falls and the value chain. Given the twofold relationship between climate change and tourism, it is worth noting that Victoria Falls and the majority of Zambezi Valley community relies on and are dependent on a water-related resource which is vulnerable to changes in climate. Fant et al. (2015), indicated that the impact of climate change in the Zambezi valley where Victoria Falls is located would be drastic. Earlier studies pointed out that runoff is going to be significantly lower in the Zambezi basin as compared to the rest of Africa (de Wit and Stankiewicz, 1999). In the next section, the impact of tourism on climate change is discussed.

2.10 The Impact of Tourism on Climate Change

Gossling (2011), noted that growth in tourism from 2050 where tourism accounted for 25 million to 924 million in 2008 had been matched with a massive increase in carbon emissions. The expansion in the tourism industry is expected to be paired with a significant upsurge in carbon emissions with a 130% growth expected from the tourism sector under a business as usual scenario (Ibid). The estimated carbon emissions are broken down and tabulated in Table 2.4. This is a significant amount which will undoubtedly further compound the challenge of climate change with adverse consequence on the tourism sector and other economic sectors.

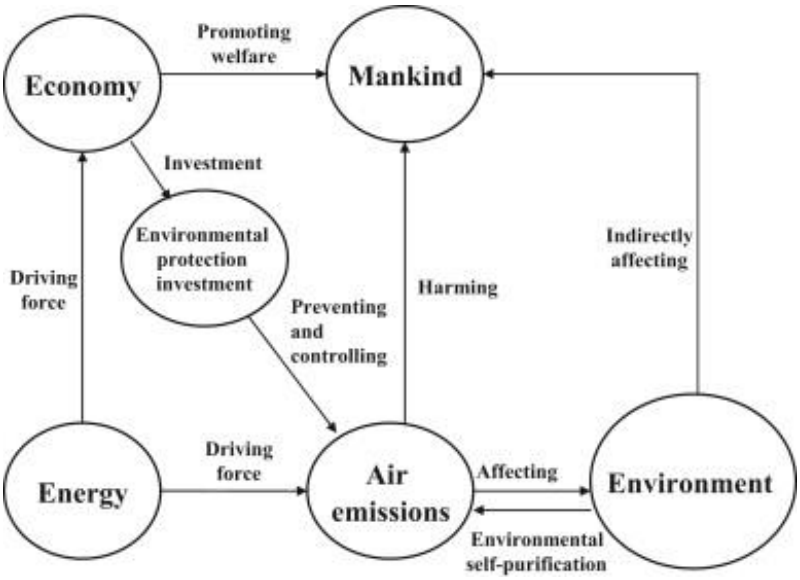
Table 2.4: Emission in 2005 and 2050 Under Business as Usual Scenario for the Tourism Sector

Sub-Sectors	2005		2035*	
	CO_2 (Mt)	%	CO_2 (Mt)	%
Air transport	515	40	1631	53
Car transport	420	32	456	15
Other transport	45	3	37	1
Accommodation	274	21	739	24
Activities	48	4	195	6
TOTAL	1,302	100	3,059	100
Total World (IPCC 2007b)	26,400			
Tourism contribution	5%			

Source: Adapted from UNWTO- UNEP- WMO (2008)

The tourism sector contributes between 4 and 10% (developing countries) and as much as 20% (developed countries) to global carbon emissions (Peeters, 2007). Tourism growth and development is often applauded for its multiplier effect on other economic sectors through a triggered effect (Lee and Brahmasrene, 2013). Scholars argue that there is a correlation between economic growth and carbon emissions (Adams and Jeanrenaud, 2008). Economic growth results in demand for more resource utilisation which often results in increased energy demand and consequent carbon footprint on the environment. Hence high energy demand and utilisation often result in increased carbon emissions. (Park and Hong, 2013).

Figure 2:7: The Relationship between Economy, Energy, Air Emissions and the Environment



Source: Zhang *et al.* (2013:261)

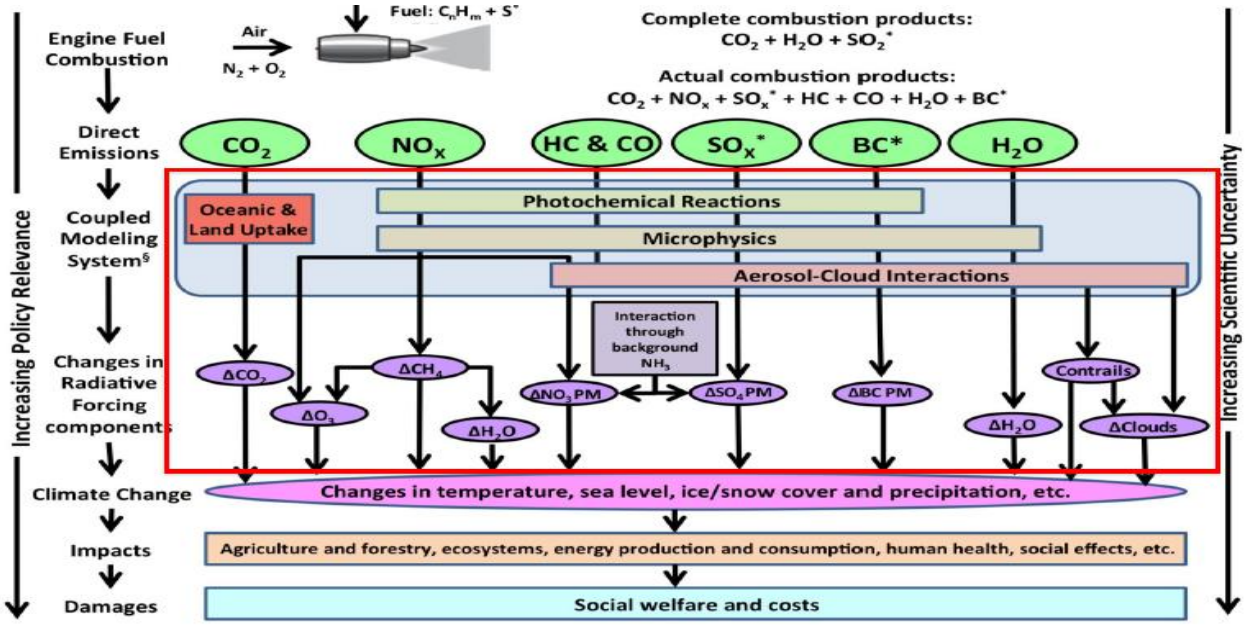
Although studies in the link between tourism growth and energy demand are few, there seems to be a consensus that a boom in tourism will create a massive demand for energy. The movement and activities that tourists undertake while at the destination result in a significant carbon footprint. However, the interface between tourism and energy or climate change remain under-researched (Becken et al*.,* 2003). This study, therefore, is set at investigating this. Katircioglu et al*.* (2013), highlighted that a study into the relationship between tourism and climate change is essential for growth in tourism often results in increased energy demands through the management of tourist destination, accommodation, transport and catering which often results in carbon footprint on the environment.

It is important to note that the bulk of direct carbon emission from the tourism industry comes from the transport sector. The transport sector accounts for about 72% with, the aviation industry contributing 40%, road transport accounting for 32%, water transport 1.5% and accommodation 21% (Eijgelaar et al., 2010). The aviation industry is a 3% single contributor to total GHG emission (Anger, 2010). The airline industry contributes to climate change through the release of carbon dioxide, sulphur dioxide, nitrogen oxide, water vapour, soot and methane as shown in Figure 2.8a Primarily; the air industry emits

all sorts of GHG that have different radiative forcing which compounds their impact on global warming. The aviation sector is a single most significant contributor of contrail that drastically reduces natural cloudiness which in a way reduces their warming effect although in total they have a net radiative effect (Burkhardt and Kärcher, 2011). Figure 2.8b shows the distribution, intensity and radiative forcing of contrail globally. It is noteworthy that the European Environment Agency (2007), reported a global aviation industry growth rate of 85%. Growth in the airline industry means an increase in greenhouse gas emission from the tourism sector's largest polluting sector.

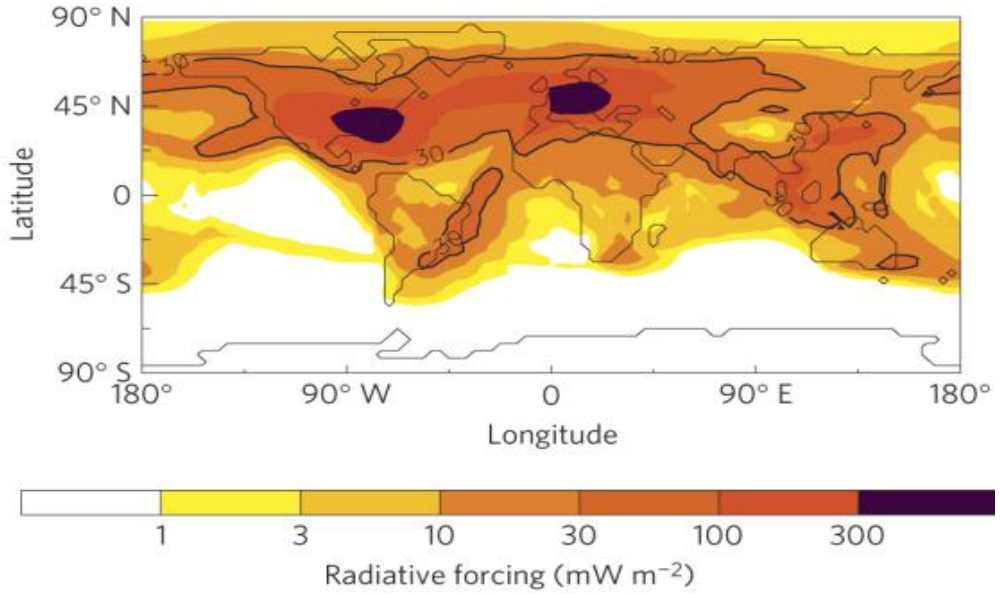
Figures 2.8 and 2.9 demosntrate the aviation impact on climate change and global distribution of corntrail cirrus radiative forcing for global aviation fleet as of 2002.

Figure 2:8. Aviation Impact on climate change and modelled impact of 100% Alternative Jet Fuels on future Emission Scenarios



Source: Brasseur et al. (2016:563)

Figure 2:9: Global distribution of contrail cirrus radiative forcing for the airline fleet in 2002 from a global climate model with full contrail parameterisation



Source: Burkhardt and Kärcher (2011:56)

Tourism is also a significant resource utilisation industries which use numerous resources that have a bearing on the environment. The industry makes use of land, and lots of vegetation and animals are either killed or displaced in the process which disturbs the ecosystem and ecosystem services (Gossling and Peeters, 2015a). The construction of infrastructures such as roads, airports, hotels and other such amenities leads to clearance of large vegetation areas which results in huge carbon footprints (Gossling et al*.,* 2002). The carbon emissions are as a result of reduced sinks (Nhamo, 2011). Tracing the impact of cement manufacturing plants that manufacture cement used in the construction of tourism infrastructure points to an enormous indirect carbon footprint for the tourism sector. Some studies have been conducted to ascertain the amount of water that is used in the tourism industry. However little is known about how much food is consumed by the tourism sector. The indirect impact of the tourism industry on climate change through the agricultural production sector value chain is huge and can never be underestimated (Gossling et al., 2011b).

If the fight against climate change is to be won, everyone involved in the tourism value chain has to adopt the best environmental practice to reduce the carbon footprint per

tourist. Filimonau et al. (2013), advocated for the evaluation of both direct and indirect carbon footprints of tourism and developed conceptual guidelines for tourism carbon emissions.

Of late, the tourism sector has been increasingly linked to the green economy transition. The next section presents some few facts on this emerging transition and how it links to the tourism sector.

2.11 Tourism and Green Economy

Sustainability studies within the tourism industry lately have focussed on general environmental issues such as biodiversity, pollution, peace, security and climate change issues. Buckley (2012), noted that given the enormity of the challenges that the tourism industry has to grapple with the tourism sector was far from achieving sustainability. There is a growing demand for sectoral GHG reduction in the light of empirical research that concludes that climate change is human-induced globally. Michailidou et al. (2016), urged the tourism industry to urgently take measures to deal with climate change through adaptation and mitigation measures. In light of that, Cadarso et al. (2016), also called for a holistic approach to deal with carbon emissions in the tourism sector that addresses emissions from tourism consumption and all investments related to tourism to effectively deal with climate change through the green economy transition.

The need to adopt mitigation and adaptation within the tourism sector has been appreciated as far back as 2008 when the UNWTO, United Nations Environmental Programme (UNEP) and World Meteorological Organisation (WMO) gathered to map out a response strategy for climate change for the tourism industry (UNWTO- UNEP-WMO, 2008). The quest for the tourism industry to find a solution to the climate change challenge has been growing ever since. This research, however, has been biased in favour of some geographic regions, especially the global north.

The WTTC started working its baseline and setting ambitious targets for carbon reduction in 2009 for its short-term goals (WTTC, 2015). The pressure from extreme weather events and pressure from academics led to continued collaboration between UNEP,

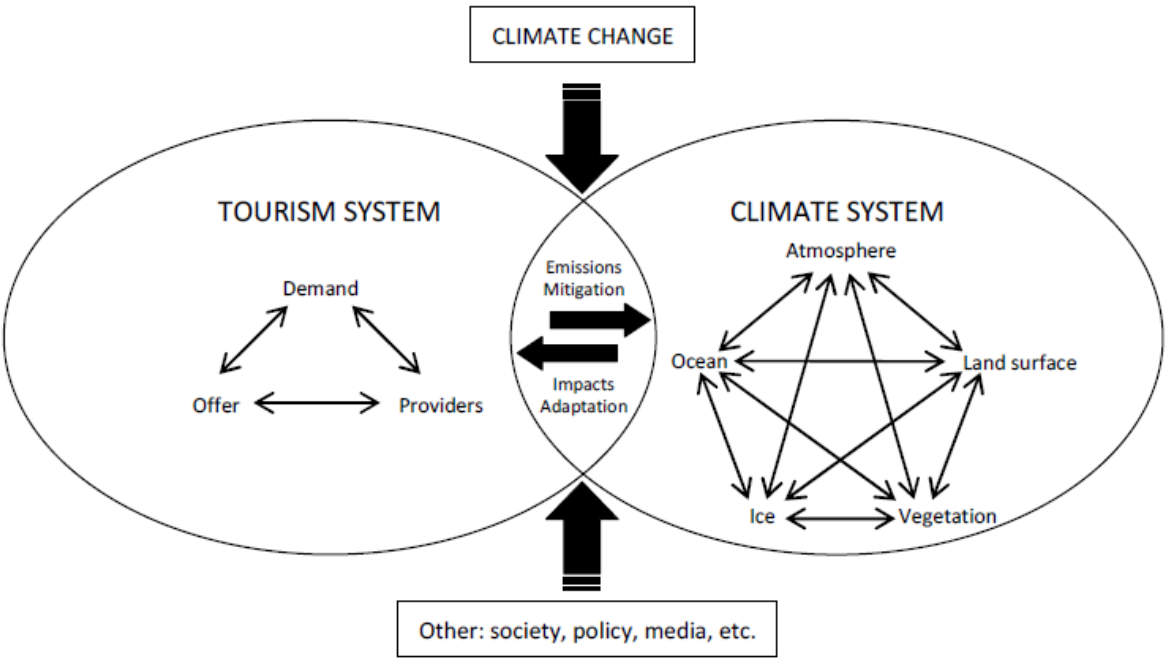
UNWTO and other stakeholders. The cooperation culminated in the development of a green economy roadmap document paving the way for the global green economy through carbon reduction and development of clean technology (UNEP, 2011). An integrated approach that was adopted shows that a green economy encompasses nine pillars that include; 'growth and economic development, environmental protection, low-carbon development, resilience, resource efficiency, ecological sustainability, human well-being, inclusiveness and equity' (Law et al., 2015:297).

Given the amount of research and available knowledge that points out to a two-way relationship between climate change and tourism, there is a need to put in place mitigation and adaptation strategies in place to deal with the challenge of climate change. Moreno (2010), proposed a model (Figure 2.10) that can be used to address the complex problem of climate change in the tourism through the green economy transition. One way of dealing with the complex issue of climate change in this model is through green tourism. Green tourism is a theoretical concept that has evolved from the dictates of sustainable development, sustainable tourism and green economy. Green economy is defined:

> "as a green economy is low-carbon, resource efficient, and socially inclusive. In a green economy, growth in income and employment are driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent loss of biodiversity and ecosystem services' (UNEP, 2011:16)."

Nhamo and Nhamo (2014), highlighted that transition to a green economy is critical in tackling climate change, promotes equitable growth, create healthy communities, leads to low carbon growth and promotes equitable growth.

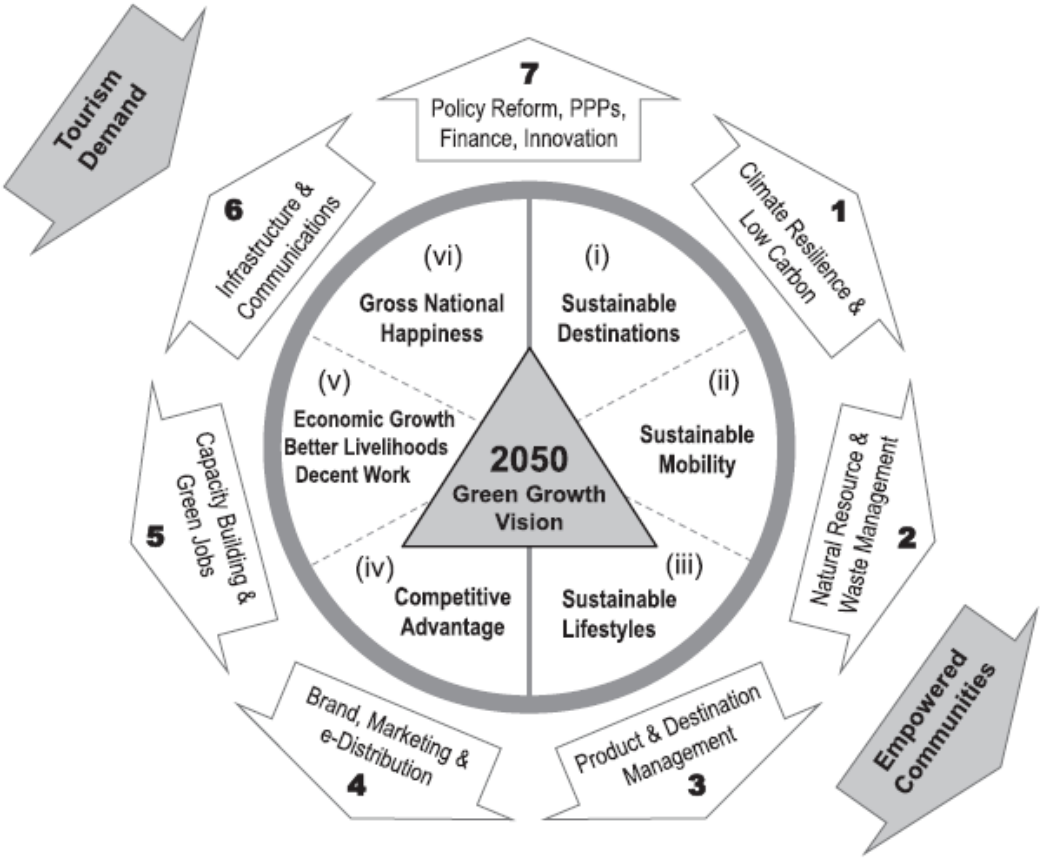
Figure 2.10: Tourism Climate Change System: A Two- Way System Model



Source: Moreno (2010b:16)

To strengthen the understanding of the green economy within the tourism context making use of the nine thematic areas identified by UNEP in 2012, Law et al. (2015), developed a model that explains green economy in a tourism context. The model shows the entire tourism value chain. It shows an appreciation of the back and forwards linkages of the tourism sector with the destination's economy and society as illustrated in Figure 2.11.

Figure 2:11: Green Economy model for tourism destination stakeholder engagement



Source: Law et al. (2015:297)

The WTTC (2015), identified five thematic areas that are set to work on with maximised commitment to effectively deal with the issue of climate change by 2035. It is scheduled to be achieved through the following measures: (i) integrating climate change into business strategy, (ii) supporting the global effort to a low carbon economy, (iii) strengthening local resilience, and (iv) engaging the value chain. Many academics doubt the tourism industry will meet this overly ambitious target in the next 17 years (Scott et al., 2016a).

The legally binding Paris Agreement on climate change has put pressure on various economic sectors to cut on their carbon emissions. The aviation industry that has been fingered as the biggest pollution culprit within the tourism sector (Gossling et al., 2016). To that effect, the industry has been making frantic efforts to reduce its carbon footprint

through various mechanisms under the leadership of International Civil Aviation Organization (ICAO). With effect from 2010, ICAO adopted a raft of aggressive measures to deal with climate change building on its earlier efforts of improving fuel efficiency. Resolution A37-19 adopted at the 37th ICAO Assembly came up with several areas of focus to deal with climate change. The areas include (i) improving fuel efficiency by 2% per annum, (ii) stabilising emissions at 2020 levels, (iii) adopting carbon certification by 2013,(iv) use of green alternative energy in the air industry and encouraging member states to develop action plans for carbon reduction among other such significant measures (ICAO, 2011). In 2013 in the quest for a decarbonised air industry, the 38th Session of the ICAO Assembly resolved to adopt Global Market Measures for air industry that are set to kick in in 2020. It also recommended new emission standards for the aeroplane industry to deal with climate change (ICAO, 2013).

2.12 Green Tourism in Zimbabwe

Zimbabwe is a leading and upcoming global tourism destination (Al-Mulali et al., 2015). However, like in any other parts of the world save for a few countries, the issue of the green economy is still in its infancy generally, and to the tourism industry in particular. In that regard, South Africa and Mauritius playing a leading role in the region on green economy initiatives (Nhamo & Nhamo, 2014). Like in other African countries, the green economy is not yet a popular thematic area (Nhamo, 2016). The Zimbabwe government identified green economy as a way of tackling the issue of climate in the context of sustainable development. The green economy transition is taken as a mitigation and adaptation strategy for reducing vulnerability amongst the poor of the poorest with a focus on women and youth (Government of Zimbabwe, 2012). There is an acknowledgement that development initiatives by both government and private actors must concentrate on reducing pollution, carbon emissions in a manner that fosters resource efficiency and maintain biodiversity and ecosystem services (UNDP, 2012; Rodgers, 2016). The country's latest economic blueprints Zimbabwe's Medium-Term Plan and ZIMASSET encompass and provide a conducive environment for green economy (Gogo, 2014).

In other parts of the world, some progress has been made in accounting for tourism emissions with research concentrated on countries such as the USA and Europe and with very little research into developing countries (Yu-guo and Zhen-fang, 2014). Zimbabwe's tourism policy that came into effect in 2015 is almost silent on the issue of climate change and the need for greening the tourism industry and only remotely refer to preference use of renewable energy in the tourism sector (Ministry of Tourism and Hospitality, 2015). To the author's knowledge, there is no study that has been conducted focussing on mitigation and adaptation in Zimbabwe in the tourism sector. However, Zimbabwe started a pilot project on green tourism with 14 tour operators in Hwange and Victoria Falls (Reinstein, 2016). Green tourism in Zimbabwe is being coordinated by three organisation namely: Green Tourism, Zimbabwe Tourism Authority and Environment Africa (Green Tourism, 2017). The three pillars of green tourism in Zimbabwe are people, place and planet with a focus on energy efficiency. It remains to be seen how this initiative will go in reducing the tourism carbon footprint in Zimbabwe.

Zimbabwe's current effort to improve the road, airport infrastructure and aggressive marketing campaign will no doubt lead to increased tourism volumes to its prime destination such as Victoria Falls (Koigi, 2017;). The recent upgrade of Victoria Falls Airport will undoubtedly lead to increased tourists and aviation traffic with several airlines showing a willingness to ply the Victoria Falls (Bwititi, 2017). An increase in tourism business will result in carbon emissions which have to be dealt with. Recent news reports of Victoria Falls drying up is also concerning, and so are prospects of increased carbon emissions. As such Zimbabwe has to fast track and intensify efforts to deal with causes and consequences of climate change.

2.13 Conclusion

It emerged from this chapter that tourism is an integral development sector for Zimbabwe and other developing economies worldwide. The dependence on most tourism economies on weather and climatic conditions put the sector under threat from the effects of climate change. On the other hand, tourism is a contributor to climate change as it accounts for about 5% of GHG with its carbon foot set to increase with the increasing

growth of the sector. The increasing impact of extreme weather events attributed to climate change has by and large an adverse effect on the tourism sector something that can affect its economic performance going forward. Given that tourism is a contributor and a victim of climate change, there is a need for the tourism industry to devise measures for adapting and mitigating climate change. One way of doing this is through increased transparency, accountability and greening the sector. Green tourism presents a chance for the tourism industry to be sustainable in the long run. However, challenges persist in going green given the lack of research in the area as such there is a need to focus studies in this field of climate change and tourism as it is beneficial for tourism stakeholders.

Chapter 3 : Research Methodology

3.1 Introduction

The chapter details and accounts for the theoretical and practical applications of the research methods. A case study approach was taken given its flexibility and advantages it offered in exploring the issues under investigation of the twin relationship between tourism and climate change. An outline and analysis of each research approach that was taken are covered, exploring the advantages and challenges of using the particular research approach from a theoretical and practical viewpoint in answering a research question. This is followed by outlining the ethical considerations and practices that were adopted in the research. An account of how data was analysed is also given. The entire step by step account of how the research was done is, therefore, the full focus of this chapter.

3.2 Research Philosophy

The field of tourism and environmental studies have been struggling to get a working research paradigm philosophy for ages. Kono (2017) and Pansiri (2006), recommend that these two-research fields given the complexity of the research they undertake must adopt pragmatism as a theoretical framework for research. In light of this recommendation, the pragmatism paradigm was chosen for use in the research design and methodological underpinnings. Pragmatism appreciates and encompasses an all-inclusive methodological approach borrowing from both the qualitative and quantitative research approach (Feilzer, 2010). The approach disentangles itself from the 'wars' of paradigms that were characteristic of the qualitative and quantitative research (Ibid).

The pragmatism approach's main assumptions are that there is no single objective reality, but the subjective inquiry is somewhat possible to conduct (Erlandson et al., 1993). Cresswell and Plano (2007) and Robson (1993), noted that pragmatism allows the "researcher to be free of methodological and practical constraints imposed by choice dichotomy between positivism and constructivism and researchers do not have to be prisoners of a particular research methodology or techniques." The major assumption is

that the world is an experiential world comprising of various strata. These strata can either be objective, subjective or a combination of the two. Fundamentally the two approaches are aimed at producing knowledge that is aimed at showing reality (Rorty, 1999). The idea is that the qualitative and quantitative approach must not be divorced but combined to work together as they do not differ at epistemological and ontological level with common areas of intersect in the inquiry (Hanson, 2008).

3.3 Research Design

A mixed method was chosen for this research project due to its applicability to the research that was being undertaken. Mixed method approach provided the researcher with several advantages that are found in the conceptual and practical framework of the research methodological approach. Morse and Niehaus (2009:14), pointed out that "mixed method design is a scientifically rigorous research project, driven by the inductive or deductive theoretical drive, and comprised of a qualitative or quantitative core component with qualitative or quantitative supplementary component (s)." On the other hand, Creswell (2014:4), argues that

> "mixed method research is an approach to an inquiry involving collecting both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks. The assumption is that the combination of qualitative and quantitative approaches provide a complete understanding of a research problem than either approach alone."

The above definition underpinnings formed the core of choosing the research design for this approach. Creswell (2015), asserted that mixed method makes use of close and open-ended data 's combined strength to make an understanding of the research problem. This strength and aspect are utilised in the designing of the questionnaire survey tools in this research. In utilising this approach statistical trends in the form of climate data that is quantitative data was combined with and personal experiences which is largely qualitative to answer the research question which either data could do unilateral (Ibid).

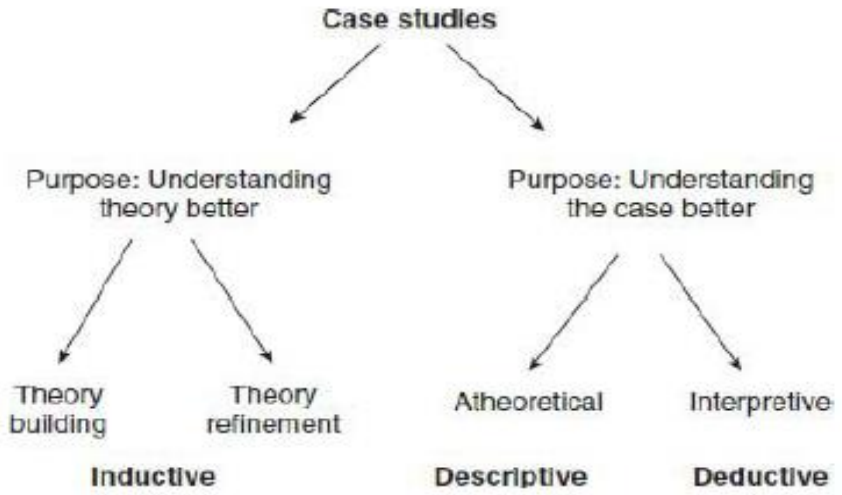
It is argued that if appropriately used with caution mixed method can be a powerful tool in answering the research question (Morse and Niehaus, 2009). Creswell, (2013); Hatch, (2002) and also Creswell and Brown (1992), highlighted that qualitative research allows for holistic accounting which assists in developing a complex picture of the research study. This study combined aspects of qualitative and quantitative research design. This allowed the researcher to explore, interpret and understand different aspects of the same phenomenon such as the experience of tourists, tourism operators and other tourism role players and behavioural response to climate change in the Victoria Falls resort. Newman and Benz (1998:3), argues that "qualitative and quantitative approaches should not be viewed as rigid, distinct categories, opposites, or dichotomies. Instead, they represent different ends of a continuum." Creswell (2014), sharing the same sentiments indicated that the two methodological approaches are not distinct as most researchers tend to more qualitative than quantitative or the opposite.

3.4 Case Study Research

A case study approach was used as the premise for this study. The use of this research methodology and debate surrounding its use dates back into the 1970s. It gained its currency and used in the 1990s and today is one of the widely used research methodologies by postgraduate students (Susam-Sarajeva, 2009; Simons, 1996; Adelman et al., 1976). A case study is defined as a multi-research methodological approach that encompasses other sub research methods such as surveys, observations, archived research and reports and interviews among others (Gillham, 2000; Jenkins and Kemmis, 1976; Yin, 1994), provided a similar definition when they postulated that a case study is an overarching term that is used to describe a bucket of methodologies that have an aim of focusing on an inquiry around an instance. Simons (1996), and also Jenkins and Kemmis (1976), noted that the case study research methodology is a form of research in its right generates a significant unique understanding of universal values. Yin (1994), gave a research operational definition of a case study by pointing out that it is a research methodology that allows the researcher to answer the how and why questions within the context of real life. Gillham (2000), noted that case studies make a strong case from utilising multiple sources of data evidence bearing on the same point.

Woodwell (2014), developed a framework to explain the case study research and the role it plays as illustrated in Figure 3.1. This framework was crucial in the research framework and theory building for this research.

Figure 3:1: Breakdown of the Purposes of Case Study Research



Source: Woodwell (2014:5)

Case study methodology was chosen because of a wide array of advantages it presents in the contribution to the body of knowledge and practical wisdom of life. There is a debate on the downside of case study research such as difficulty in generalisation, lack of independence of the researcher, the poor validity of results and tunnel vision by the investigator (Macdonald and Walke, 1975; Adelman et al., 1976; Merriam, 1988; Creswell, 1994). The researcher noted the concerns and put in place practical steps to address them. The measures taken are discussed in the next paragraphs.

In order to address the issue of researcher independence and other matters, the researcher took a professional standing and adopted a holistic observation approach based on two principles namely: a look at the study area as a whole with an open-ended attitude as advised by Verschuren (2003), and the adoption of numerous methods in gathering data (triangulation) aimed at dispelling a tunnel vision. The research questions

were used to directly guide the field observations, with iterative parallel research such as the use of strategic sampling that included snowball sampling.

Academics noted several advantages of a case study that were harnessed for this research. Some of the reasons why the case study approach was used in this research are summarised by Adelman et al. (1976:148)

a) Case study data is strong in reality;
b) The case study allows generalisations either about an instance or from an instance to class, and its strength is in attention to the subtlety and of the case in its right;
c) Case studies recognise the complexity and embeddedness of social truths and offer some support to alternative interpretations;
d) Allows further data use to post reporting to other researchers who might have a different objective; and
e) Allows the reader to judge the implications of the study implications independently.

3.5 Pilot Study

A pilot study is defined in social research as a feasibility study; which is conducted on a small-scale version of a major study or a trial run carried out in preparation for broader research (Polit *et al.,* 2001). Baker (1994), indicated that a pilot study is a process conducted as a way of pre-testing research instruments. This assertion was further supported by Last (2001) and also Everitt, (2006), who postulated that pilot studies are a critical part of research as they allow for testing of methods and procedures that will be on a larger research project. The National Institute for Health Research (2017), highlighted an important part of the pilot study when they pointed out that pilot studies are necessary for ensuring that all research components are working together smoothly. Such components include recruitment, treatment, randomization and follow-up assessments. It is in that context that a pilot study was undertaken between November 2016 and March 2017.

The pilot studies offered some benefits to the research process and findings. It ultimately was part of an effort to increase the reliability and validity of this research as exposed by Gudmundsdottir and Brock-Utne (2010) as well as Lancaster (2015).

During the pilot study process, the researcher visited the Ministry of Tourism and Hospitality in Zimbabwe at the end of November 2016 to pre-test the questionnaire guide and also to assist in identifying more respondents for the questionnaire interview and the focus group discussion. The engagement with the Victoria Falls local municipality, Zambezi River Authority and the Ministry of Tourism and Hospitality officials who are a pivotal role player in tourism in the Victoria Falls was eye-opening as it helped the researcher to refine the question and focus of the study.

Critical players who were not initially envisaged during the design process were identified which was crucial in the triangulation of data. The researcher gathered more information about the research area which went a long way in assisting in identifying potential problems in the research process during fieldwork and data collection especially from certain sections of respondents. The researcher had to modify some issues to suit the cultural and political set-up of the country. Tayeb (2001), emphasised the need for cultural sensitivity in research which needs to be addressed during the piloting stage. This assisted in improving the research protocol, quality and led to an efficient data collection process.

The online survey (tool) was piloted between November 2016 to early January 2017. The online questionnaire was piloted first with key informants before it was piloted with tourists and other stakeholders. The key informants were people holding a Doctoral degree and Professors and a few ordinary citizens who are familiar with the study area and knowledgeable on the issues of tourism and climate change. These people have either conducted research or spent time at the Victoria Falls as tourists. The process was critical in that it served as an eye-opener for the research process that was to follow.

Key informants assisted in highlighting some technical issues with the online questionnaire. Such technical issues ranged from website settings to issues to do with language, interpretation of the questions and terms, and the time it would take to complete

the questionnaire. It also covered ethical matters regarding allowing respondents to give their consent to take part in the survey and or exit when they feel the need to do so. After this process, some issues that were open or those that required much writing were closed or adjusted to reduce the time people spend completing the questionnaire at the same time not compromising the research objectives and design such as assessing the perceptions of tourist on the impact of climate change. The web settings were adapted to make it easy to skip questions without affecting the submission upon completion. The first stage of online survey piloting was positive as it boosted the confidence of the researcher with both the tool and the validated the instrument for administering to the next stage of piloting. This is in line with claims by Kezar (2000) that a pilot study is a critical tool for enhancing understanding of research area and assist in refining research design helping to build the confidence of the researcher during the research process.

After expert piloting, the online survey tool was administered to tourists and stakeholders across the world. The tool was either emailed with an introductory note and a link to the survey or posted on social media where tourists frequent to post their experience to Victoria Falls. It was picked up that the questionnaire was working as expected and the tool was working as per design specifications. It was noted that the completion rate was very high as 79 people clicked to start the survey and 40 people managed to complete the survey on average ten minutes. The QuestionPro which was used website has a tool that allows the researcher to tell at what stage the respondents dropped out during the survey and their location on the globe. According to the report generated online, respondents that dropped out of the survey left at the introduction stage that contained the consent form where respondents had to agree to before clicking to start the interview. Given the completion rate of slightly over 51% against the online completion rate that can go as low as 28% and fall into single digits in some cases (Lampe et al., 2012), it was agreed that the approach was fit for use. Minor modifications to the scale were done to the online tool after the pilot. It was also learnt that to improve completion rates, some questionnaires had to be self-administered and to embed the survey onto companies operating in Victoria Falls to generate data expeditiously. It emerged that emailed questionnaires needed to follow up to boost the competition rate.

A preliminary visit to the field was crucial as it allowed the researcher to have a better appreciation of the study area, culture, beliefs and practices for the area. The researcher was able to properly plan the field activities and do proper and adequate budgeting for the main fieldwork. The researcher was able to pick up logistical issues and timing of the field work that helped in smooth fieldwork during the main data gathering period.

In summary, the pilot study was invaluable to the research as it provided the researcher ample time to reflect on the research design and processes, which made field work a lot easier, manageable and adjustments made to research tools and design process enhanced validity and reliability of the research findings.

3.6 Sampling

Sampling is a critical component of both qualitative and quantitative research methodology. Kumar (2014:229), define sampling as “the process of selecting a few (a sample) from a bigger group (the sampling population) as the basis for estimating or predicting the prevalence of unknown piece of information, situation or outcome pertaining the bigger group.” Sampling is critical in researching an economic and meaningful way. Given the scope and nature of this research where the extent and nature of the population under study was unknown and spread across the whole world, a non-probability sampling technique was used to address the research question. Non-probability sampling is selected in a non-determined way or theory (Babbie, 2014). The following techniques were used in the non-probability sampling: purposive sampling, snowball sampling and expert sampling.

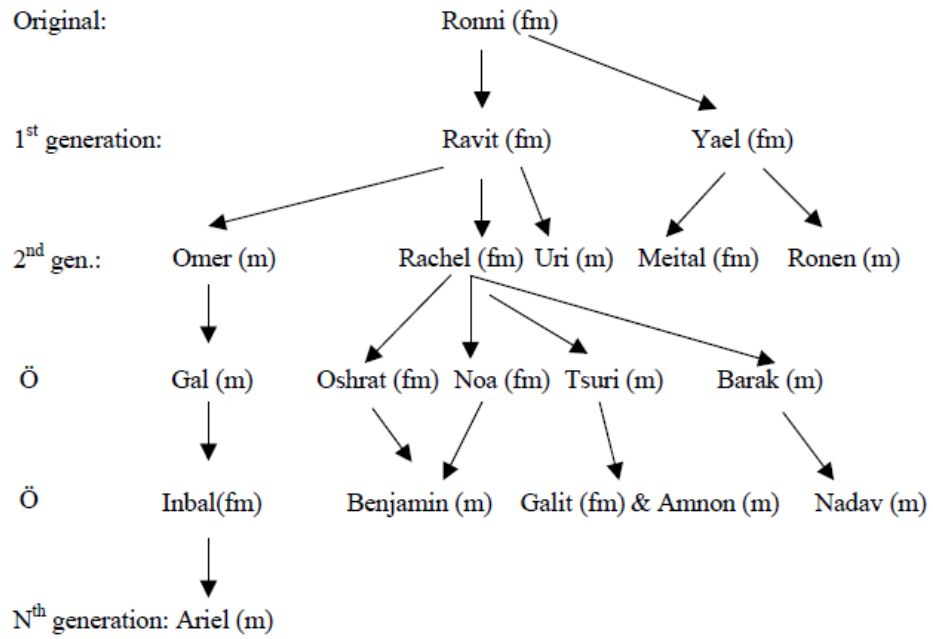
3.6.1 Snowball Sampling

Noy (2008), defined snowball sampling as a method that is widely used in qualitative research through obtaining information from referrals of people with knowledge on a certain research area under focus. Key challenges of using this sampling technique include difficulty in finding the first respondent, challenges with verification of interviewees and controlling the chain in a sample (Gilbert, 2001). Some of the criticism, however, pertains to circumstances where the research deals with sensitive issues (Browne, 2005).

Attention was paid to offset the shortcomings of this sampling technique. Noy (2008:330), noted that “snowball sampling is sometimes used as the main vehicle through which informants are accessed, or as an auxiliary means which informants are accessed, or as an auxiliary means which assists researchers in enriching sampling clusters, and in accessing new participants and social groups when other contacts have dried up.” The method is useful in finding hard to reach populations (Browne, 2005; Eland-Goossensen et al.,1997).

Snowball sampling was used to identify senior citizens who have been residents of the Victoria Falls for an extended period as this would host rich historical information about the Victoria Falls resort and the Zambezi River flow regime. This group was critical in providing interview data on account of the climate and hydrological history of the Zambezi river and the falls. The same technique was used to identify seasoned fishers along the Zambezi River who provided data on changes on the Zambezi River over the years. The snowball stemma developed by Noy (2008). Figure 3.2 illustrates how this technique was used in data gathering.

Figure 3:2: Snow Ball Sampling



Source: Noy (2008:333)

3.6.2 Purposive Sampling

Guarte and Barrios (2006:277), “defines purposive sampling as a random selection of sampling units within the segment of the population with the most information on the characteristic of interest.” This method has about six categories which are based on the need to achieve compatibility and achieving representativeness namely: intensity sampling, reputational sampling, typical case sampling, maximum variation sampling, homogenous sampling and deviant sampling (Teddlie and Yu, 2007; Palys, 2008). In the designing and conducting the research, strategic choices and decisions had to be made about where, how and who had to be part of the research to meaningful address the research question. Purposive sampling was chosen because of its ability to research question under study. Its design is principally concerned with generalisation to an external context of the study population which is part of external validity (Teddlie and Yu, 2007). The method is also economical in that it allows for the careful use of a small population or cases to yield rich information about the intricate link between tourism and climate change. The sampling frame was informed by the expert judgement of the supervisors and specialists in the field. The technique offers some advantages in comparison to other sampling techniques such as probability sampling.

The researcher used the technique to identify participants for Focus Group Discussions, and respondents for interviews. To recruit respondents for focus group discussions, the researchers looked at the role played by an individual or their institution in the tourism industry. Information gathered included the history and experiences of the tourism sector, impact of extreme weather events on tourism operations and activities in the resort town and how they responded to these and how they plan to deal with them in the future.

3.6.3 Expert Sampling

The process included a deliberate effort to select respondents who have skills and knowledgeable in a particular field that was central to the research. Experts that were contacted include meteorological experts, aviation experts, wildlife experts and hydrological experts to provide their expert opinion to some of the research questions.

The experts mainly were there to respond to the question on the evidence of climate change and their potential impact on various sectors of the tourism industry.

3.7 Data Collection Tools

Given the multidisciplinary scope of the research question, a multi-method approach was used in the collection of data that allowed for various research issues and objectives to be fully addressed. While some tools addressed a single objective or research question, other instruments were designed to gather data for more than one objective or research question. The use of various tools to collect data was aimed at increasing reach, reliability and validity of the results as different methods used allowed for the collection of data from various sources to answer a single research question. For this study, during the designing of the research tools, careful attention was given to ensure that every aspect link to either one or more objective or question. This was deliberate to make sure that there is a clear focus on the research question. Each tool was further designed with a clear focus on the target group and the type of respondents it was designed for. The research collection instruments were tailored to respond to the shortcomings of the other tools that were used in the research with a complementary approach in mind. The following methods were applied namely: two sets of online surveys, FGD, remote sensing, face to face interviews, field observations, online content analysis and snowball sampling. The following section is going to explore how each of the techniques was used in the study.

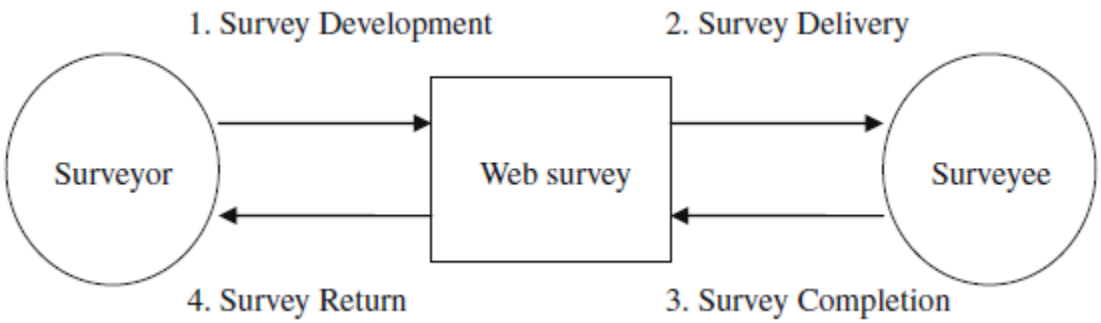
3.7.1 Online Questionnaire Survey

The online questionnaire survey was utilised to collect data from tourism stakeholders including tourists. The questionnaire survey's use has gained prominence and uses in research due to the various advantages that it presented to the research community (Couper, 2000; Sue and Ritter, 2016). The tool was used because the researcher had skills and expertise to design, administer and distribute the survey given the prior experience of using the tool which hosted by QuestionPro. The research tool afforded the researcher an opportunity to reach out to a wider global community to get as far and wide responses as possible. Victoria Falls is an international icon feature which attracts people from across the world as it the world's seven world wonder. No other tool could have been

used to gather such a wide audience in an economic, timeouts and convenient manner. Although the use of online surveys is criticised for being selective regarding who can respond and for poor response rate (Fan and Yan, 2010), the researcher found ways of making up for the shortcoming through complimentary self-administered questionnaires. It was noted that it had numerous advantages as it provided several advantages. The online surveys provided wide geographic reach, efficient and allowed for direct data entry and timeous interface with certain ability to conduct an instant analysis of data as illustrated in Figure 3.3. The online survey provided the additional advantage of providing multimedia into the questionnaire.

Fan and Yan (2010), pointed out that the response rate was often low in web surveys and often affected by the topic and how long the study took to complete. There was a deliberate effort to address this by making the surveys very short with average competition time pegged at seven minutes. The effort was to design an easy to complete the questionnaire as realistically as possible.

Figure 3:3: The Web Survey Process



Source: Fan and Yan (2010:133)

The twin online surveys were well designed to make it easy and quick to complete. The first part of the online questionnaire comprised of a short paragraph consisting of invitation, introduction and consent statements that were approved by the college ethics committee. Upon clicking the consent button, the respondent was taken to a page that had questions. The first questionnaire had a maximum of 24 questions for completion by tourists and the second, the stakeholder questionnaire comprised of 17 questions. Most

of these were simple open and close-ended questions with options to tick, rate and dropped down menu for others. This made it easy for respondents to easily and quickly complete the survey minimising random dropouts. Information collected online include tourists' environmental observations and experiences on their interactions with Victoria Falls resort. Questions also sought to gather evidence of climate change they had observed between visits for repeat visitors, their climate preferences, perceptions on the impact of climate change and the expected aesthetic view of the Vitoria Falls. On the other tool for stakeholders that was administered to tour operators, a stakeholder in the tourism industry and senior residents of Victoria Falls. Questions were on observed changes, experiences, the impact of changes in tourism business activities, impacts and adaptation measures they are employing to deal with climate change amongst others. Upon completion, there was a click submit button which prompted a thank you and option to share button.

The online survey had a sharing platform that allowed easy of sharing through email and social platforms such as Facebook, Twitter and LinkedIn. There was also an option to send a QR code, embed as pop up onto another website and an email option. For easy sharing a customised invitation email with a link was made for easy distribution and sharing. The emails addresses were obtained from various websites of government and private players operating in the Victoria Falls and other non-stakeholders with interest in Victoria Falls. These addresses were then used to send an invitation to survey and a link to the website where respondents would be taken to the study. The target was all businesses operating in the area of Victoria Falls. Social Media was used to post an invitation and link to the survey. These platforms are accessible to all tourists visiting the Victoria Falls. Anonymity was ensured as no email or name was collected on the platform. However, the geotagging feature on the website allowed for the recording of the country where the response came from and automatically record it on the map. The researcher could see all the countries where respondents came from. Purposive convenient sampling technique was used in the administering of this tool.

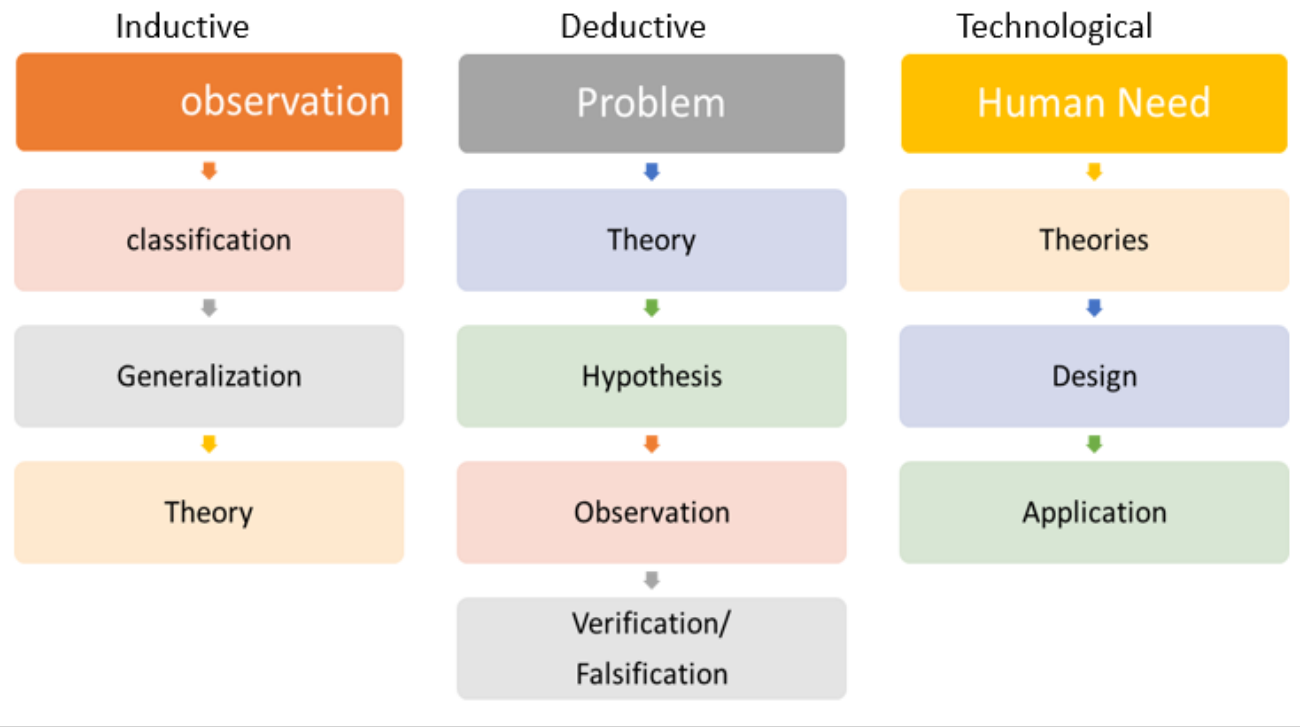
3.7.3 Remote Sensing

Remote sensing was used to collect imagery data in assessing evidence of the impact of climate change and extreme weather events on the waterfalls at Victoria Falls. According to Meer (2012), remote sensing is the art of obtaining information about an objecting without getting into contact with it that is done by measuring radiation signals from the object in question. There has been a growth in the use of remote sensing tools to map and monitor land use and land cover over time (Hansen et al., 2008; Wu et al., 2010). Due to rapid development in remote sensing in the global north rapid change detection can be undertaken at a global, regional and in some instances local scale on a daily basis. This provides for a better understanding of how human beings are interacting with the world and permits a better understanding of the earth human relationship (Lu et al*.,* 2004). Mouat et al. (1993:39), defines and explains change detection "as a process for determining and evaluating differences in a variety of surface phenomena over time." This change detection is a powerful and essential tool for Geographic Information Systems (GIS) as it is critical for ecologists and other resource planners in decision making.

The airborne satellites are capable of providing imagery spanning over time for the entire world providing a global picture that will ordinarily not be possible ages before the era of remote sensing (Graetz, 1990). The advent of supercomputers and the ability for the satellite to provide a synoptic overview and produce high-resolution data has led to the significant use of remote sensing in change detection. Change monitoring is a growing field due to rapid changes in the world due to climate change and weather extreme events and other human developments. Remote sensing has lately been used to monitor land use change (Yang and Lo, 2002), the movement of refugees in Syria, the impact of hurricanes, the impact of tsunamis with the capacity to provide real-time imagery as a number of satellite missions in space increases with high-resolution capabilities. Satellites allow for viewing of the world (Earth Observation) in greater detail than before. As of 13 January 2017, there were 29 satellites in mission observing Earth from 29 different geographical places (ESA, 2017). These missions acquire data on various geographic components of the land and water surfaces allowing for change detection.

Remote sensing can be used as a methodological approach for observation, theory building and verification to meet human needs in the field and study of Geography as illustrated in Figure 3.4.

Figure 3:4: Remote Sensing Methodologies in Geography



Source: Adapted from Curran (1987:1257)

Lu et al. (2014), developed a series of steps and procedures that need to be followed when conducting research using remote sensing. These series of measures and procedures were religiously followed in this research are illustrated in Table 3.1.

Table 3.1 Major Steps and corresponding contents for conducting change detection analysis

Major steps	Main contents
Describe the nature of change detection problems	Research problems and objectives
	Geographic location and size
	Time period
	Change detection system
	Accuracy requirement
Select suitable remotely sensed data	The characteristics of remote sensing data
	Consideration of atmospheric & environmental conditions
	Characteristics of the landscape under investigation
Conduct image preprocessing	Geometric rectification/registration
	Radiometric and atmospheric correction
	Topographic correction if needed
Select suitable variables	Different features inherent remote sensing data
	Per-pixel-based variables from image transform or vegetation index
	Sub-pixel-based variables from unmixing processing such as spectral mixture analysis
	Spatial features such as textural images
	Thematic variables from image segmentation or classification
Select suitable change detection algorithms	The characteristics of change detection algorithms
	Selection of suitable algorithms
	Comparison of different algorithms if needed
Evaluate change detection results	Determination of sampling strategy and sample size
	Collection of reference data
	Accuracy assessment

Source: Lu et al., (2014:15)

3.7.4 Direct Observation

Direct observation is a widely-used method as part of the triangulation process both in quantitative and qualitative research with extensive use in social science and educational research (Punch, 2009). With the research question in mind, the semi-structured direct observation was conducted to track evidence of climate change at the Victoria Falls and Kariba. The process involved taking notes and pictures using a camera with geotagging capabilities. The narrative recording was also undertaken to harness all the observations in a detailed manner as possible so as not to forget some of the aspects. Professional and objectivity were maintained to ensure independence and non-bias and ensure data integrity and reliability (Kumar, 2014). Information that was collected includes water flow

regime pattern, flooding pattern and river level changes over the years. Permission was sought from the relevant authorities to collect such data in photo format. The process was assisted by local experienced, seasoned tour guides and people who know the hydrological history of the area. Field observation was also extended to wildlife impacts within the national parks.

Direct observation was also used to assess the levels of green technology investment in various tourism establishments. Mitigation and adaptation is a significant part of climate change resilience as such direct observation was conducted to check the levels of mitigation and adaption strategies that are in place.

3.7.5 Self-Administered Questionnaire and Interviews

An interview is defined as an interaction between a researcher and the researched individually to collect information about a subject matter (Burns, 1997). An interview was chosen because of a number of advantages it offers to the researcher. The researcher has the flexibility to vary the structure and wording to suit the conditions. It also allowed for further explanation and or probing if the respondents did not quite understand the question. The researcher could also reorder the questions and at the same time maintaining natural flow (Kumar, 2014). Semi-structured in-depth interviews were conducted with tourism industry players government and experts who are knowledgeable about the area and the subject of tourism and climate change. This was done to mine their views on how climate change is affecting the area, their experiences and to find out measures if any that they have put in place to deal with multiple weather extreme events that have affected the area in recent past. Probing was used to get more clarity on grey areas. An appointment and request for interviews were sent in advance to identified respondents before the interviews through email and telephone calls. Before interviews, permission from the respondents was obtained, and the answers were recorded using a tape recorder and notes were diarised by the researcher for analysis.

A questionnaire is defined as a list of questions to address a research question or questions (Kumar, 2014). Self-administered questionnaires were distributed to tourists and other tourism stakeholders to gather information on how climate change is affecting

the tourism industry and how tourism is affecting climate change in the area. This was conducted as a complementary activity to online surveys and responses were recorded and uploaded online. The researcher chose the method to boost the response rate and was carried out to reach the saturation levels. Up to 20 complementary surveys were done and were brought to 447 to the total number of response to the survey. Timing was critical to make the process not boring but also economical to both the researcher and the respondents regarding time and financial resources. Tour operators had to explain how climate change is affecting tourism activities in the area and measures they were putting in place to deal with climate change and their perceptions about the future. The tourists had to respond to questions that address the perceptions of the tourists on the issue of climate change and tourism in the resort town.

3.7.6 Focus Group Discussions

Focus group discussion (FGD) is a data collection method that involves collecting data from some participants at a goal in a relatively unstructured but guided manner (Braun & Clarke, 2013). The use of this method in social science has seen tremendous growth since its development by Robert Merton and colleagues around 1940 (Merton & Kendall, 1946; Merton,1987).The method is preferred as it offers multiple advantages that have proved crucial to research. Some of the benefits of using this technique are that it offers a relaxed atmosphere for participants to engage in issues that might even be sensitive paving the way for disclosure and allowing for flexibility in issues that the researcher might not have anticipated.

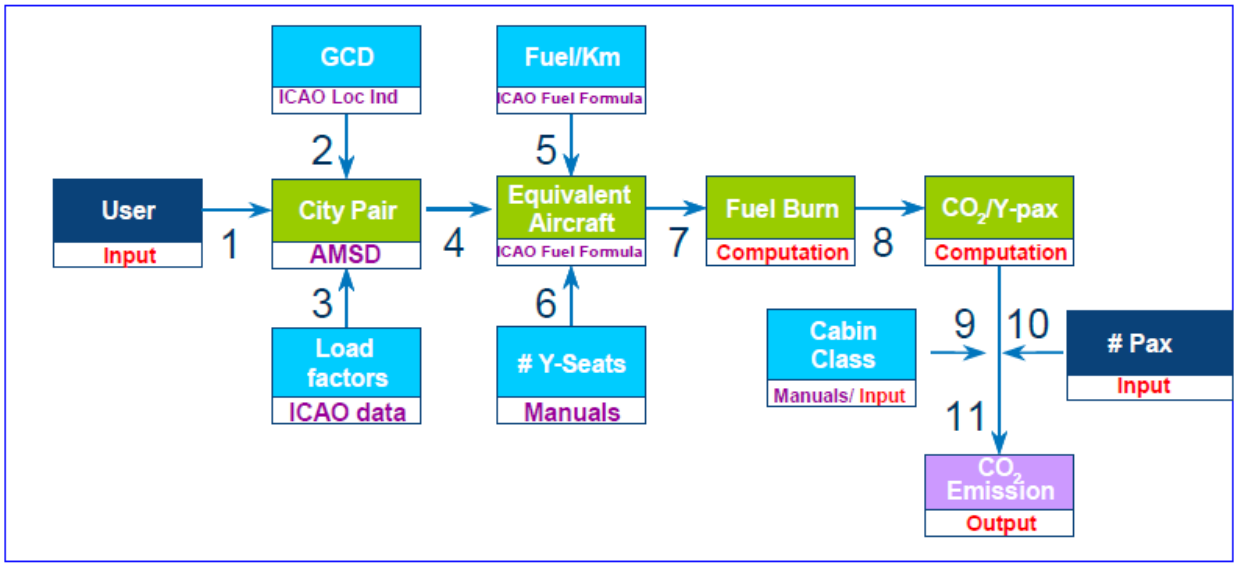
The technique presents some challenges as big groups can be challenging to manage, the possibility for participants to wander off topic, dominating characters might manipulate the group among other such factors which the researcher was careful to avoid during the moderation process (Carey and Asbury, 2016). Purposive sampling was used to assemble participants for FGD discussion. The researcher used the assistance of municipal officials and government organisations in the area which assisted with identifying and coordinating members for the discussion. A pre-constructed discussion guide was used during the deliberations which lasted between one hour to one and half hours. Group meetings were facilitated by the researcher. The groups comprised of

between 10 and 15 members who were given a fair chance to express their views on the research question as advised by Witte and Davis (2013).

3.7.7 Carbon Foot Print Airlines

A schedule of airlines that ply the Victoria Falls International Airport, the Kasane International Airport and the Livingstone Airport was obtained from the regulating authorities, whereupon estimated carbon emissions for each route were calculated using web-based ICAO (Carbon Emissions Calculator) Version 9. The ICAO recommends the use of the calculator as it captures and gives average estimates of each route based on the type of flight, number of passengers, distance, fuel consumption for that route and other flight parameters which might be difficult to capture on a flight-specific scenario. According to Baumeister (2017), this method has been endorsed as the principal scientific method for use in aviation emission calculation. The calculator has been used by several other scholars (for instance, El Hanandeh, 2013; Lu & Shon, 2012). Figure 2 highlights the procedure that is taken in calculating the carbon footprint for each airline.

Figure 3:5: ICAO carbon calculation procedure



Source: (ICAO, 2016b: 4)

The ICAO and IATA recommend the use of guidance provided by the Quality Assurance Standard (QAS) to determine the carbon equivalent and radiative forcing. QAS is

mandated by these two organisations to audit the calculation entry of carbon emissions and offsetting data (IATA, 2015). QAS (2016) recommended the use of the United States Environmental Protection Agency (EPA) calculator in calculating the amount of carbon dioxide and offsetting projects. The EPA's Greenhouse Gas Equivalencies Calculator was used in the calculation of the carbon equivalent and offsets standard in line with aviation regulatory standards.

3.8 Content Analysis

Content analysis was conducted as part of the research methodology and as part of the final analysis of open-ended questionnaire interviews as part of the final analysis to interpret findings. Content from blogs such as TripAdvisor and Google Review for Victoria Falls was analysed to get the views, opinions and perceptions of tourists about the effects of climate change on tourism and activities in Victoria Falls. TripAdvisor is a platform that is used to market and sell tourism products with a platform for tourists to provide feedback on their experience. Post are moderated before published on the platform. Reviews posted by all the tourists were reviewed with a view of picking up issues that are raised by tourists which relate to the impact of weather extremes, seasonal variations and weather in general on their stay and enjoyment of the resort and activities and these views were transcribed to a digital document for later analysis. Kaplan and Haenlein (2010) and also Mangold and Flands (2009), argues that using tourism blogs to analyse customer perceptions is a common methodological approach that is widely accepted in the study of tourism.

3.9 Secondary Data Analysis

Burton (2011), notes that secondary data analysis as the exploration of existing data set such as archived survey data, official records, tape-recorded interviews and recorded interviews. It offers an opportunity for a researcher to give a new interpretation, knowledge and conclusions that are different from the ones presented in the original record (Schutt, 2007). Secondary data analysis' use is growing given the broad access to archived records in today's digital age (Bulmer et al*.,* 2009; Middleton et al*.,* 2014). The use of this methodology is attributed to the advantages that it offers to the researcher.

Burton (2011), argues that secondary data analysis provide readily available, cheap to obtain data for students and early researchers who do not have huge funding for research and publishing. Chow and Kennedy (2014), also noted that it provides a researcher with an extensive data set which will not ordinarily be possible for primary research. Burton (2011), further explain that secondary data has an advantage in longitudinal research which is hard for students to undertake effectively within the normal three to five year registration period. The cost-effectiveness of the data adds to its appeal. While there are many advantages to always keep in mind validity and reliability issues as different nationalities use various conventions which might compromise the final results (Burton, 2011).

Secondary data was obtained to triangulate data on the impact of climate change. Climate data were collected from official government institutions and parastatals which are mandated to work in the field of concern. Climate records were obtained from the Meteorological Services Department of Zimbabwe (MSD) and The Zambia Meteorological Department (ZMD), which is the official meteorological and climatology service provider for Zimbabwe. The MSD is also an ISO 9001 certified organisation for aviation meteorological data for Victoria Falls International Airport and other airports in the country. It is affiliated with International Civil Aviation Organization (ICAO), and WMO as such their data is considered highly reliable and valid. Climate parameter data was collected for a month on month for the period 1980 to 2016 for observation and analysis.

Hydrological data for Victoria Falls Big Tree station were collected from Zambezi River Authority. This organisation is a body corporate that was established under acts of parliament by both Zimbabwe and Zambia under Zambezi River Authority Acts (Chapters 467 and 20:23 of the Laws of Zambia and Zimbabwe, respectively). The institution is mandated with managing the affairs of the Zambezi River on behalf of Zimbabwe and Zambian government. Part of what they do is to record hydrological data along the river and record the dam levels at Kariba. Historical hydrological data was collected and tabulated for analysis.

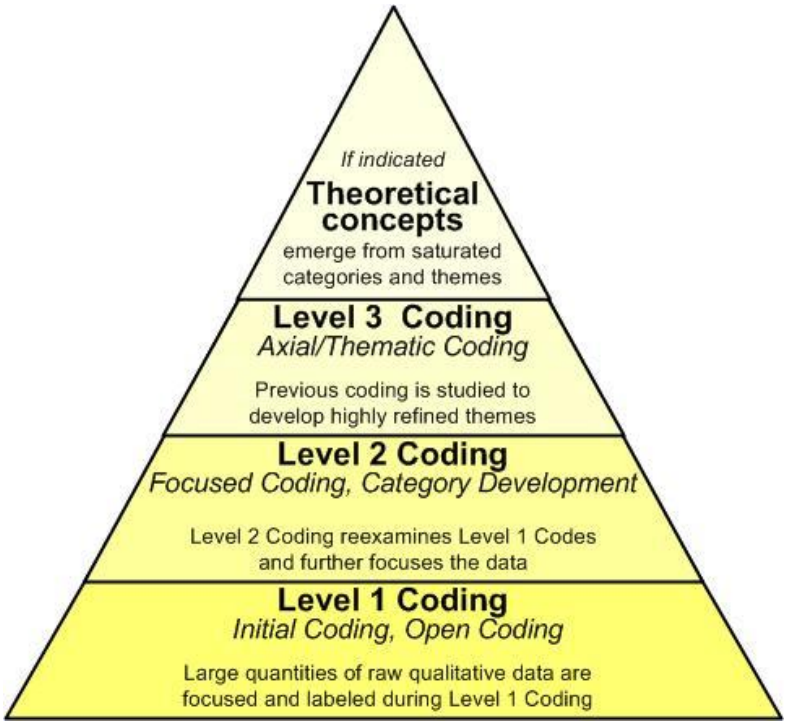
Besides climate data, annual financial reports and sustainability reports and projects report for airlines were reviewed to ascertain the various projects and initiatives that are being taken to curb the carbon emissions by the aviation sector. This was done because most airlines offices were beyond the reach of the researcher geographically or airlines were unwilling to share data. Data were analysed for reporting purposes.

3.10 Analysis of Results

After data was collected various analysis techniques were employed to make sense of the collected data so that it responds to the research question. The data analysis process was guided by the thematic analysis theory which is a flexible method and foundational. Thematic analysis theory seeks to find themes and patterns from data sets linking them to the research question. The theory dictates generation of analysis through a bottom-up approach with researcher's standpoint in analysis and field knowledge and epistemology (Braun and Clarke, 2006). Data that was collected from interviews was sent for transcribing by a professional transcriber into digital data.

The transcribing involves transcribing word for word and all the figures of speech. The researcher verified the accuracy of the transcribed data with the original recordings to assess accuracy. Upon satisfaction that the transcribing went well, the data was then the data was coded using ATLAS.ti into various themes. The coding process followed the steps that are highlighted in Figure 3.5. An open mind approach was taken in the development of codes for the research in line with expected dictates (Braun and Clarke, 2013; Davies and Hughes, 2014). Thematic analysis of data was conducted bearing in mind the research questions, aims and objectives of the research output data were then verified through triangulation and member checking. This part of the process includes comparing findings from one research instrument with findings from another research instrument. Member verification was a process of taking preliminary findings to the tourism community in Victoria Falls to present preliminary findings to verify the findings and ascertain the accuracy of the findings as advised by Harvey (2015).

Figure 3:6: The Major Steps Followed in Coding



Source: Hahn (2008:1)

Imagery from Remote sensing was analysed using Geographic Information Analysis Tools from ArcMap 10.3.1. The findings were triangulated with climate and hydrological data that were analysed using Microsoft Excel Tool Pack that assisted in producing diagrams and graphs to give it a visual impression.

A Mann-Kendall trend test was also run for the annual data to ascertain the significance of change (if any) over the period in question. Regardless of its limitations in that it does not give the structure of the trend since the negatives tend to cancel the positives, the Mann- Kendall trend test is widely used and accepted for use in detecting a change of environmental parameters such as hydrology and climate data (Pohlert, 2018). A sequential was applied to individuals to produce a graph to be able to detect and get a clearer picture of the events under investigation in line with a recommendation by Rahman et al. (2017). The Sen's Slope estimation was used to estimate the magnitude of the trends of rainfall for Livingstone town. In running Mann-Kendall trend test, if the p-value is less than the significance level α (alpha) = 0.05, H_0 (null hypothesis) is rejected.

Rejecting the H_0 indicates that there is a trend in the time series while accepting H_0 indicates no trend in the time series. In rejecting H_0, the result is statistically significant (Karmeshu, 2012).

Online collected data was also analysed using the inbuilt analysis capability of QuestionPro. The online survey website is capable of conducting simple statistics and provide a quick interface for inputted data. The other analysis that could not be analysed by Questionpro was exported to SPSS for further analysis. Once the outcome report was available data was then triangulated with data from other research techniques for final analysis and report compilation.

3.11 Ethical Considerations

The issues of ethics were given serious consideration during the planning, fieldwork and reporting of research findings. The research was carried out in line with UNISA Research Policy of 2013 and Universal Declaration on Bioethics and Human Rights of 2005. The research was approved by the College of Agriculture and Environmental Sciences (CAES) with a Research Ethics Review Reference Clearance Number 2016/CAES/107 (Appendix A). Approval to conduct research was also granted by The Municipality of Victoria Falls in Zimbabwe (Appendix A) and cleared by Ministry of Tourism and Hospitality. The researcher and the associated organisation and its employees did not have a vested interest in the site which could have influenced the research and the research outcome (Creswell, 2014).

The respondents and participants in the research were all requested permission to research a written consent form that was approved by the Ethics Committee. The consent form was written in a clear simple to understand language. Linked to the consent forms were three dictates that included the provision of information and voluntary and or non-coerced participation (Farrimond, 2013). Participants were informed of the objective and purpose of the research, their role, what participation entails and how data will be used and reported before participating in the research. Part of the rights that they were informed of included the right to withdraw at any time of the investigation process if they were unhappy (Davies and Hughes, 2014).

Also, questionnaire and interview guides were properly scrutinised to ensure that they were free from any issue that might result in harm, emotional upset of respondents or participants or feel guilt. No one or organisation was, prejudiced or harmed during the research process. The research was designed, conducted and reported in a manner that respects diversity regarding gender, colour, creed, sexual orientation and or disability amongst participants. No vulnerable groups were involved in any part of the research. Confidentiality was assured through anonymity throughout the research process. No name or any form of identification was collected during the research which could lead to the traceback of research participants. All collected data were digitised and stored in a 3D secure website or on a password-protected cloud account. The results were also reported as an aggregate to protect participants in the research from being identified.

3.12 Reliability and Validity

Kumar (2014), postulates that reliability refers to whether the data collection techniques and analytical procedures were replicated will produce similar or near similar findings. On the other hand, validity refers to whether the research measures what it seeks to measure. These two complementary aspects of research are important in establishing the trustworthiness, dependability and worthiness of the findings To ensure reliability and validity, a series of steps and procedures were initiated throughout the research process from research design, data collection, analysis and reporting of results (Ibid).

As part of ensuring the reliability and validity of the findings, the methodological design was carefully done through the establishment of a logical link between the questions and objectives, especially for interview guides and questionnaires. An intensive methodological study of methods used for near similar studies was conducted to ensure content validity and reliability from a methodological perspective. Primary research tools were pretested to check question consistency with, supervisors, typical respondents and with expert academics in the field with adjustments were made where possible to ensure the integrity of findings.

Triangulation and paralleling of procedure were conducted to ensure external consistency (Hanumanthappa, 2014). Statistical analysis was also carried out to measure standard deviation, standard error, confidence interval and mean to check reliability (Ayyub and McCuen, 2011). Respondents were drawn from across the world with respondents from across all continents except for South America. The research sought representative across the socio-economic-political divide to ensure the representativeness of the data. The respondents voluntarily participated in the research and had the option to withdraw from the process at any time even after the research. The research was conducted over a lengthy period spanning several months in a relaxed atmosphere to ensure the reliability of the findings. A preliminary report was taken back to the study area for findings confirmation or rejection to assess the level of acceptance before the final report was compiled.

Where the researcher was not fully competent in a particular data collection method, two or more specialists were consulted to assist in the methodological process with the draft report sent back to the specialists to verify the results before the compilation of the final report. A multi-method was also critical in ensuring that more than one source confirms findings.

3.13 Conclusion

The chapter presented the necessary steps that were used to collect data from both primary sources and secondary sources providing a step by step process. It emerged from the chapter that a case study mixed method approach was used in this research with Pragmatism theoretical framework being used. The research used various techniques such as online survey, secondary data analysis, field observation, remote sensing and interview amongst others to generate data that answers the research question. Snowball sampling, purposive and expert sampling were used to identify ideal participants for the research. The research was conducted ethically in line with universal ethical standards. Data analysis was done using different tools best fit for the data that was generated such as using ICAO calculator, Mann-Kendall Trend Analysis, Microsoft Excel Toolpak, SPSS and content analysis. The various methods and techniques that were used assisted in responding to the three research questions and three objectives

that were set out in chapter ones. Each research question was addressed by two or more techniques to ensure reliability and validity. The last part highlights the processes that were followed in analysing data. The chapter paves the way for the next chapter on results presentation.

Chapter 4 : Evidence of Climate Variability and Change in Victoria Falls

4.1 Introduction

This chapter highlights findings on the tracking of evidence of climate variability and change in the Victoria Falls resort. As indicated in the methodology chapter, various sources of data were used to respond to the second research objective that focused on determining the evidence of climate variability and change on Victoria Falls resort. Rainfall and temperature patterns, river hydrographs, and field data were analysed for this purpose over a period of 40 years.

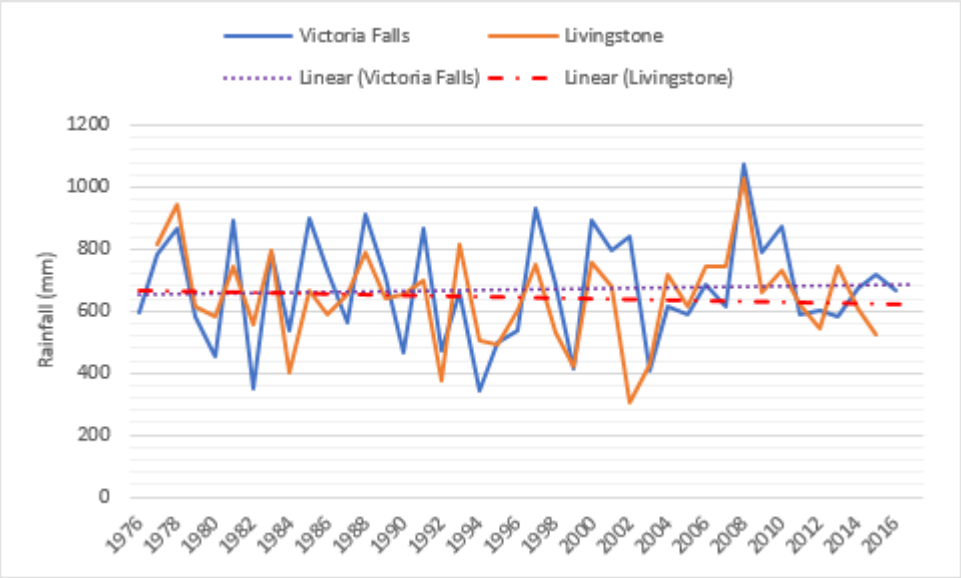
4.2 Rainfall Pattern 1976-2017

Rainfall data was sampled from two stations namely: the Victoria Falls station and the Livingstone meteorological station that is located at the Victoria Falls International Airport on the Zimbabwean side and the Livingstone International Airport on the Zambian side respectively. The Livingstone station is north of the waterfalls whereas the Victoria Falls lies South of the Victoria Falls waterfalls. The distance between the two meteorological stations is 40km. Although the two stations are 40km apart, they are on different sides of the river and different altitude with the Victoria Falls at a higher altitude of 1064m and David Livingstone at 986m above sea level accounting for an altitude difference of 78m. The two stations are in the Zambezi Basin within the semi-arid regions of Zimbabwe and Zambia. Rainfall takes place in summer which is hot and humid with the winter season being cold and dry.

It emerged that the rainfall pattern on the two stations shows many similarities with minor differences as shown in Figure 4.1. The difference could be attributed to the altitude difference between the two places. The two stations indicate that the rainfall pattern is highly variable and difficult to predict as demonstrated by extreme swings of lows and highs from year to year and season to season. Over a 40-year period, there is evidence of a slight decline in rainfall amount on the Livingstone side. Rainfall at the Victoria Falls station shows stability with a slight increase over the same period. It was found both stations have not recorded any statistical difference in rainfall change over the period under investigation with Victoria Falls ($p=0.780$ $\alpha 0.05$) and Livingstone

(p=0.59 α.0.05) The small rainfall change confirms the findings by Conway et al. (2015) who noted this trend along the Victoria Falls part of the Zambezi River Basin (See Section 2.6).

Figure 4:1: Total Annual Rainfall (1976-2016)



Source: Field Work (2017)

There is also evidence of climate variability on a year to year basis, which can be attributed to increased incidence of El Niño and La Niña incidence over the region which is compounded by global warming that leads to climate change. As a consequence, some years are extremely wet, and others are extremely arid. The climate for the area exhibits increased extreme weather. Davey et al.'s (2011) warned that incidences of El Niño and La Niña amplified by climate change would result in weather anomalies over the region as reported in Section 2.4.

The highest and most wet year over the 40-year period was recorded in 2008. In that year the Livingstone station recorded high rainfall of 1,027mm against an annual average of 644mm. The lowest amount for the station, 306mm, was recorded in 2002 and this was less than half of the normal average rainfall. The Victoria Falls station recorded slightly more rainfall than Livingstone in 2008 where 1,071mm was received which was a record high for the 40-year period. On the other hand, the lowest rainfall receipts were in 1994 where a total of 343mm was received. This was against a long-term rainfall average of 670mm.

On an annual cycle, the Livingstone Station reported 15 years of below the average expected annual rainfall in the last 26 years, while the Victoria Falls station recorded 19 years of rainfall below the mean. This shows that there is an increase in drought occurrence in the area posing a threat to vegetation, animal and water bodies in the area. Of the five driest years recorded for the Victoria Falls station, three features in the past 26 years, while four out of five of those years were reported in the same period in Livingstone town.

A close look at the rainfall pattern suggests that the area suffers occasional droughts and experience dotted fluxes of severe rainfall. An estimated 10 meteorological drought years were recorded between 1976 and 2016 at the Livingstone station and about 19 years from the Victoria Falls station. In recent past, however, data shows that the episodes of drought have become more frequent and prolonged, spanning as much as three to four years in duration. The 2011 drought lasted four consecutive years with rainfall consistently falling below average in Victoria Falls. In Livingstone, severe droughts were reported in 2011/12 and 2014/15 rainy season.

The increased drought occurrence has implications for flora and fauna including the aquatic life in the area and surrounding national parks. Droughts tend to disturb biogeochemical cycles and consequently ecosystems as net primary productivity is often compromised. There is evidence that suggests that drought patterns promote bush encroachment thereby further reducing food available for animals. This may result in reduced animal reproduction, and population growth is hampered as some animal species fail to adapt.

Kogan (2010), observed rapid vegetation deterioration in most drought years over the area attributed to drought-related extreme temperatures. A reduction in vegetation cover will potentially affect herbivores and consequently carnivores which make up the Big Five of the Zambezi valley. Wildlife act as a secondary attraction to the Victoria Falls and as such they are an important tourist attraction. Most importantly since river flow regimes follow the precipitation pattern, the river systems will fluctuate further and potentially result in less water flow at the Victoria Falls attraction.

While there is evidence of slight changes in annual rainfall pattern, there is evidence of changes in rainfall data on a month on month basis except for the two months of

March and December. These trends are similar for both stations over the past 40 years (Figures 4.2a&b).

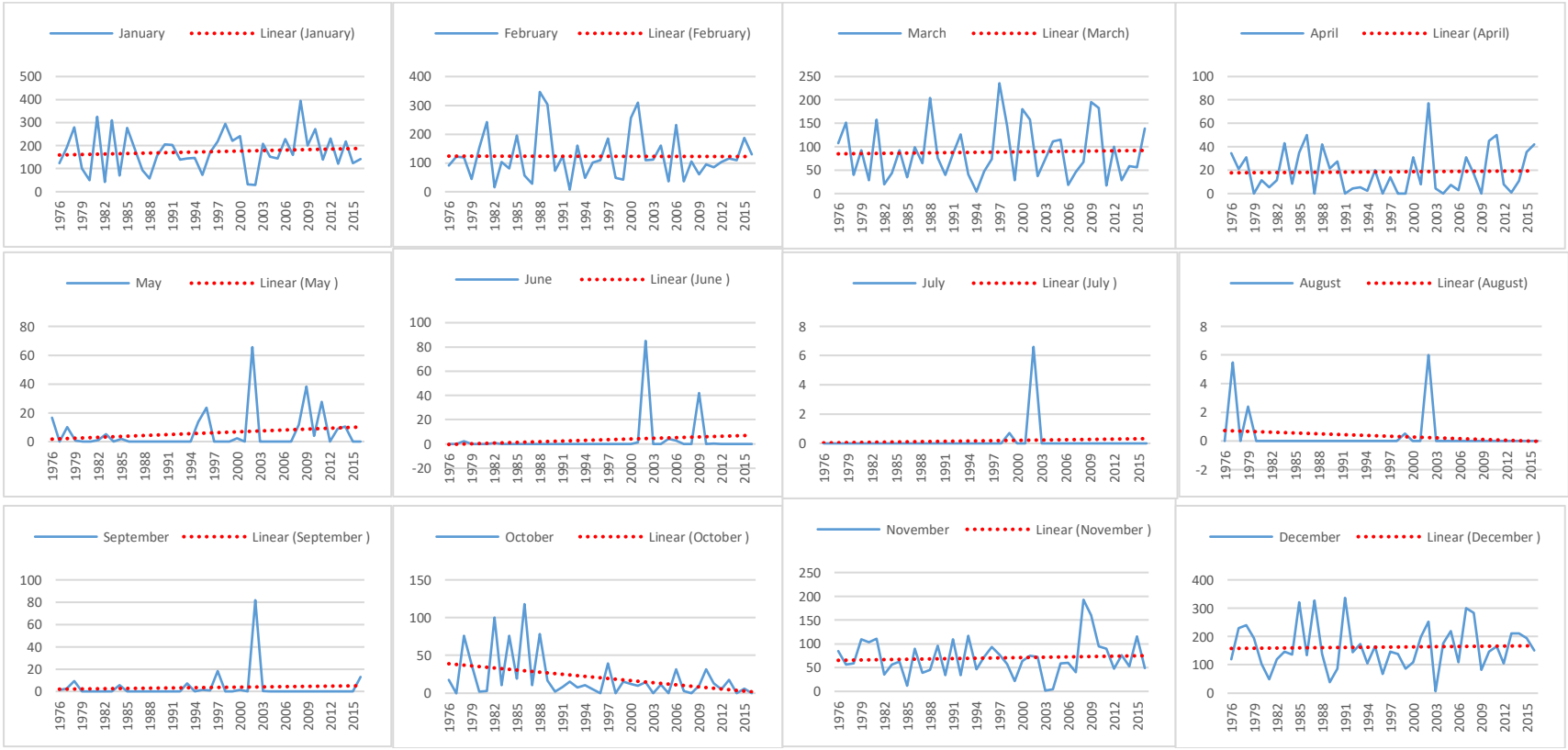
Climate variability has been evident with extremes of high rainfall recorded in 2010 and 2015 where 143mm and 141mm were registered for April in Livingstone compared to its long-term average of 19mm. This was followed by years of extreme aridity. High incidence of climate variability in the Victoria Falls confirms earlier findings by Muchuru et al. (2016), who observed a similar trend.

The month of October has been marked by significant changes as there is evidence of drying up during the month over the years at both stations. Rainfall for October stood at 40mm in Victoria Falls and 48mm in Livingstone in 1976. These figures were reduced to about 0mm recorded in 2016. The findings are a departure from what Unganai (1997), had observed that rainfall in the area starts in October through to April (Section 2.6). The drop from 40mm to 0mm in October signifies a delay in the onset of the rainy season. The results confirm findings by Marvel et al. (2017) that climate change will result in a temporal and spatial shift in rainfall pattern. Evidence shows that the rainfall season at both stations is now starting in November instead of the historic month of October with no indication that the rain season extends to May. This implies that the rainfall season has been shortened by about one month. However, there is an increase in rainfall amount in November. The delay in the onset of rain season could have ramifications on animal habitat, animal migration patterns and flora and fauna life cycles in the Victoria Falls.

The research further found that November and January were now recording more rainfall than usual. In 1976 the normal rainfall amount for January was about 180mm in Victoria Falls and about 110mm in Livingstone. For the past 10 years, the two stations have been recording about 200mm for the period in question.

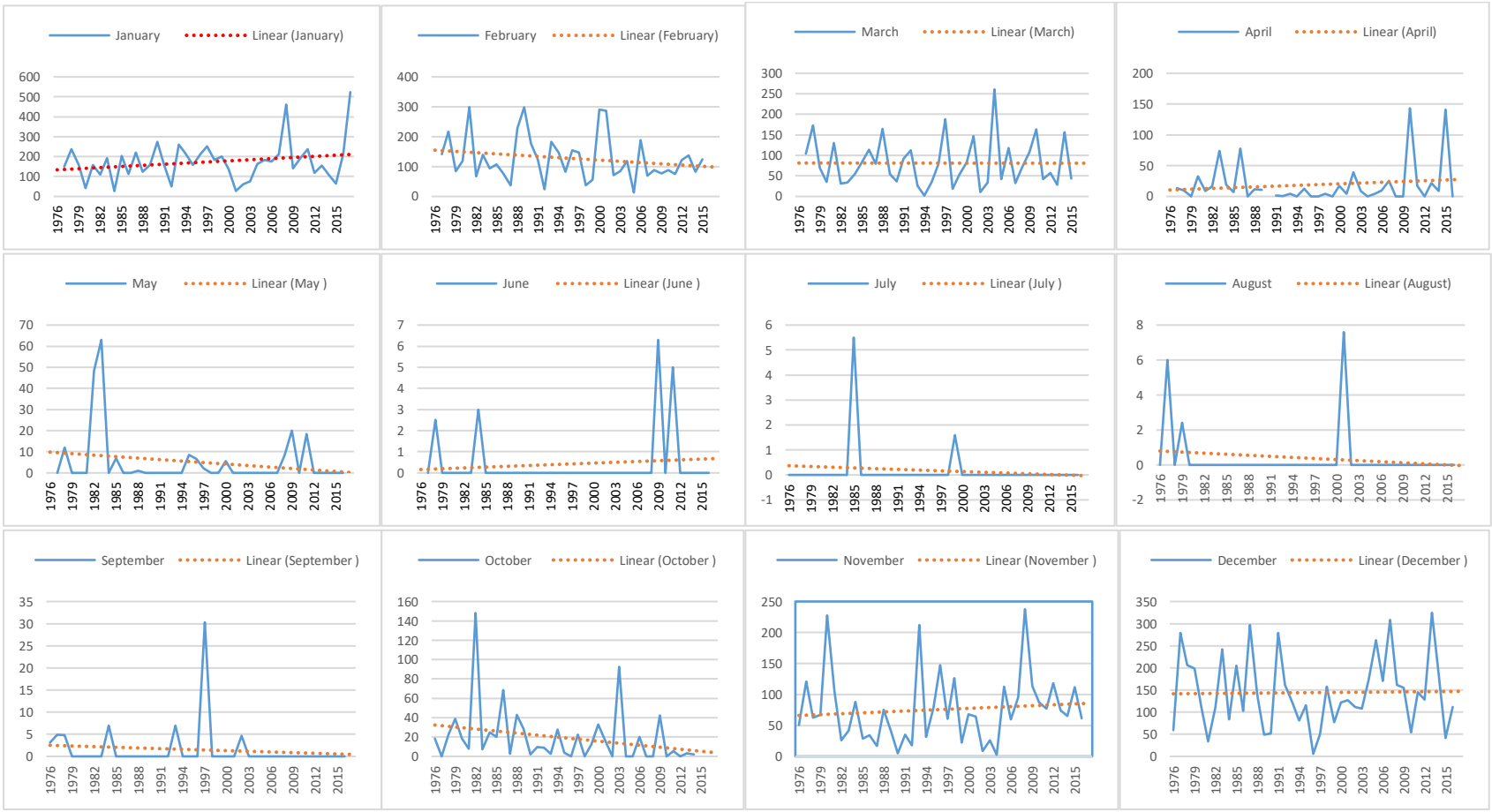
Figure 4:2a&b: Rainfall Pattern Victoria Falls and Livingstone 1976-2016

Figure 4:2a: Rainfall Pattern Victoria Falls, Zimbabwe (1976-2016)



Source: Field Work (2017)

Figure 4.2b: Rainfall Pattern Livingstone, Zambia (1976-2016)



Source: Fieldwork (2017)

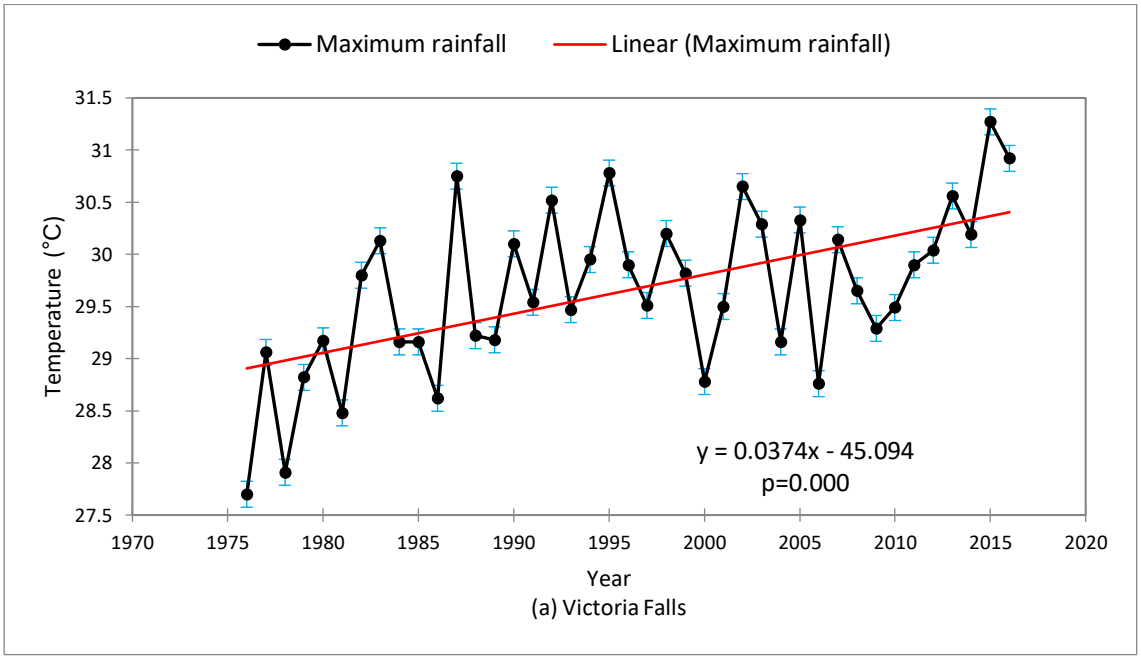
Increased rainfall intensity over a short period could result in increased surface runoff as precipitation quickly exceeds infiltration capacity. This could result in increased river discharge over a short period marked by picked water fluxes. This could be a blessing and a curse for the tourism industry. High river discharge results in an increased aesthetic value of the waterfalls and the Victoria Falls rainforest. From the tourist's survey, it emerged that tourists enjoy seeing the falls at full discharge. However, increased discharge may lead to activities such as white-water rafting and swimming at the devil's pool to be temporarily closed.

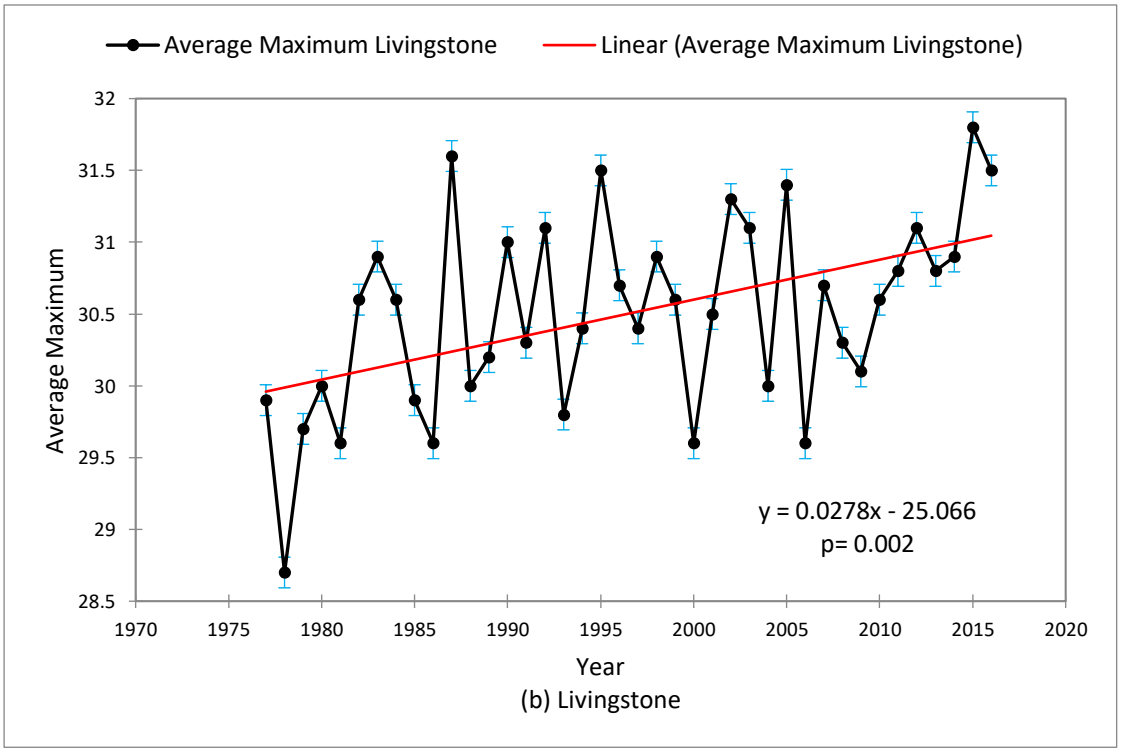
4.3 Maximum Temperature Patterns Victoria Falls 1976-2016

Field data suggest strong evidence of warming between 1976 and 2016 (Figure 4.3). On the Victoria Falls station temperature trends indicate an increase of about 1.4 °C. The same trends are reflected at the Livingstone station where temperature increased by an average of 1 °C. The temperature increase at both stations was found to be statistically significant on Mann- Kendall trend analysis as shown in Figure 4.3a and 4.3b. The difference of 0.6 °C was unexpected given the proximity of the two stations.

The results confirm earlier findings by IPCC (2000), that Southern Africa warmed by about 0.1 °C and 0.3 °C per decade between 1960 and 2000. Such differences could be attributed to differences in elevation. Such high temperature may affect tourist comfort and flora and fauna that must adapt to the ever-increasing temperatures. An adverse increase in temperature is likely to hurt animal well-being and plant phenology with a knock-on effect on producers and the entire food chain market as noted earlier on by Fitchett et al. (2015) (Section 2.6).

Figure 4:3: Annual Maximum Average Temperature for Victoria Falls and Livingstone station





Source: Field Work (2017)

Evidence suggests that warming has accelerated in recent years due to climate change and climate variability that saw an increased incidence of the ENSO phenomenon. There was an increase in the number of years that exceeded the 40-year average over the past decade. In Livingstone, all the years post 2010 had their maximum temperature above the 40-year average of 30.5 °C Over the past 40 years,

18 years recorded temperature above average. As from 1976 to 1995, seven out of 20 years recorded above average temperature. This trend is in sharp contrast to the period 1996 to 2016 where 14 out of 20 years witnessed above average temperatures. During the last decade, a notable variation is that the highest temperature for the 40-years was witnessed in 2015 where the mercury rose to 31.8°C

From the Victoria Falls station, the average temperature for the 40-year period is 29.65°C. Over this period, 20 years recorded above average temperatures. Between 1976 and 1995, only seven years recorded above average temperature while the remainder 13 of the 20 years were recorded in the last 20 years from 1996 to 2016. In the past decade, however, only three years were below average with seven years recording temperature above average. All the past six years from 2016 had above-average temperatures, with the record highest temperature being in 2015 where the mercury rose to 31.3°C. Overall, the last decade (2006-2016) has been the warmest during the period under review at both stations.

In as much as there were increases in annual mean maximum temperature, month on month data present other insights (Figures 4.4a&b). Serdeczny et al. (2017), had noted that climate change would result in intraseasonal and monthly temperature changes in Southern Africa. As such it was not surprising to see that some months showed huge temperature increases, while others showed slight changes and yet others show no changes. The months of December, January, February and March show no change over the period in question at both stations with their average temperature around 30°C. However, from the Victoria Falls Station, the month of May maintains a steady temperature of about 30°C. On the other hand, in Livingstone, the month realised temperature increases of 1°C over the same period from 28.1°C to 29°C.

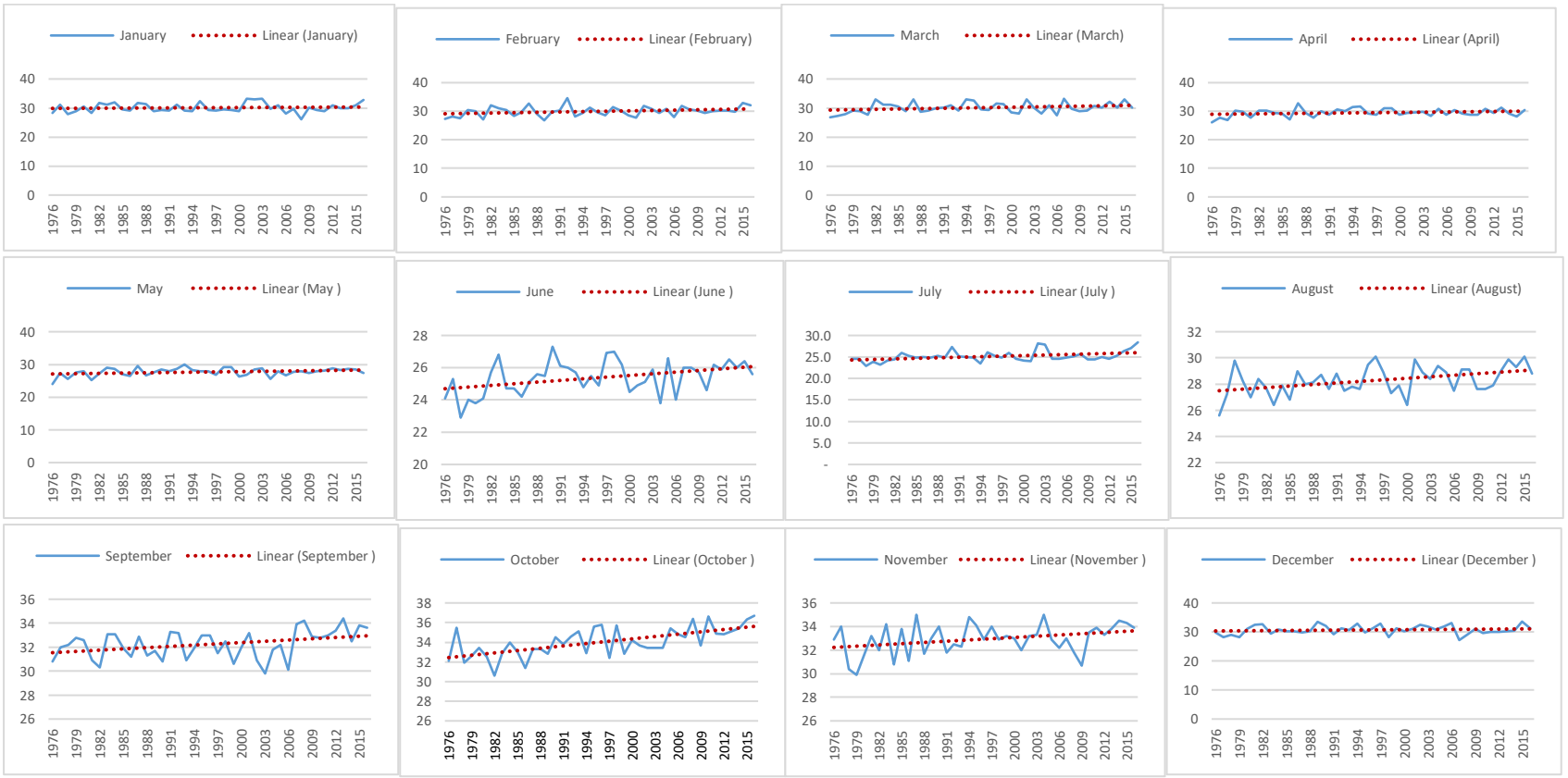
The historical winter month of June witnessed a 1°C increase between 1976 and 2016 at both stations. However, there was no significant increase in temperature for July. The month of August in Livingstone was steady at 30°C while in Victoria Falls a 1°C increase was reported in August. There was warming during the winter months at both stations. Such trends have the potential to affect plants growth in winter. However, the trends may have added the advantage of decreasing energy demand for heating, thereby lowering the energy bill during winter months in the hospitality industry.

Reducing energy demand directly lead to reduced carbon emissions, which is positive regarding mitigating global warming and climate change from tourism activities.

The months of September, October and November recorded the most significant temperature increases over the past 40 years, with October recording the highest temperature increase at both stations. September in Livingstone realised a temperature rise from an estimated 32.8°C in 1976 to about 34.05°C in 2016 while the temperature in Victoria Falls increased from an estimated 31.9°C to about 33°C. This signifies more than a one-degree temperature increase at both stations. November was also similar in that there was more than a degree temperature increase at both stations.

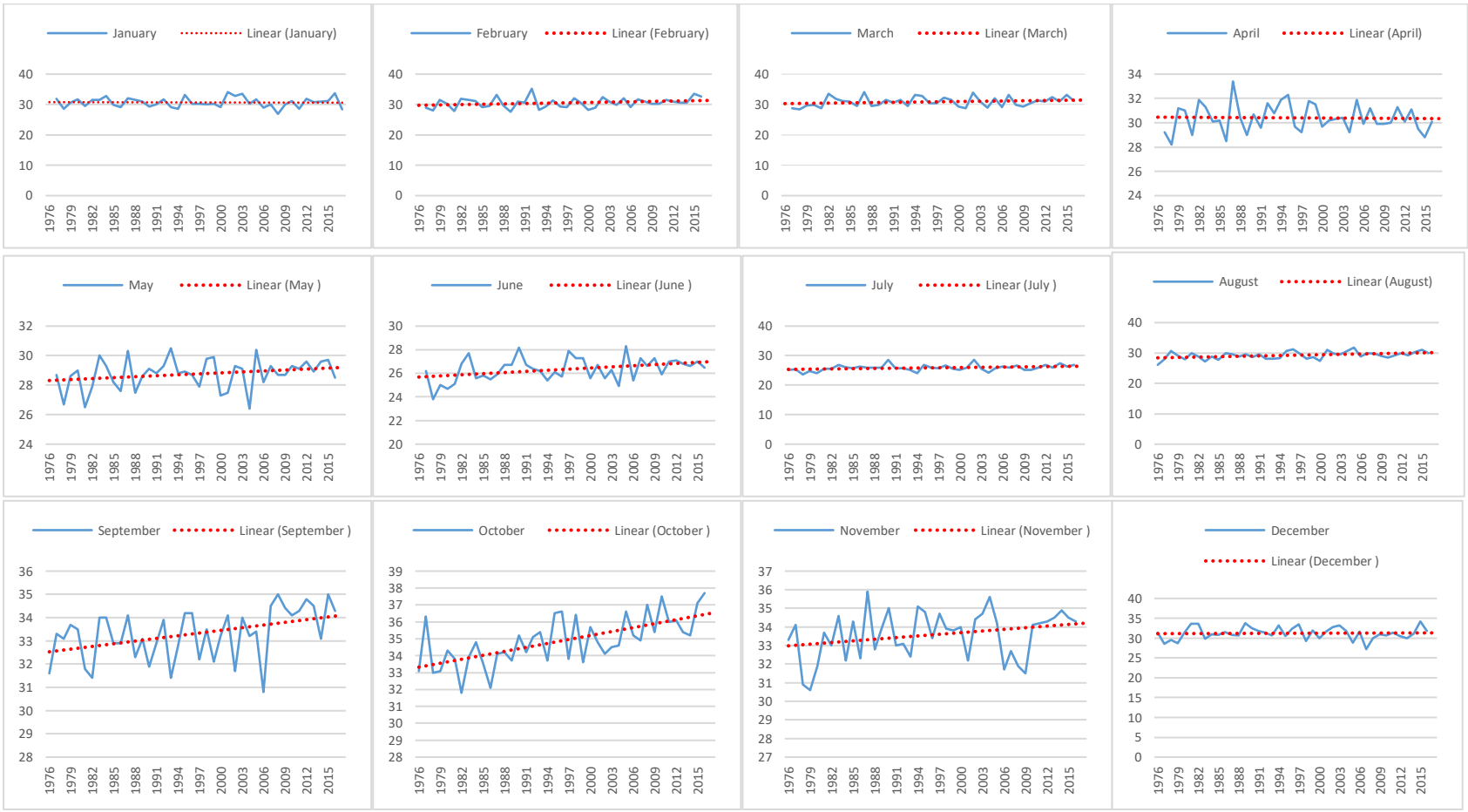
Figure 4:4a&b Trends in Victoria Falls and Livingstone Maximum Temperature 1976-2016

Figure 4.4a Trends in Victoria Falls Maximum Temperature (1976-2016).



Source: Fieldwork (2017)

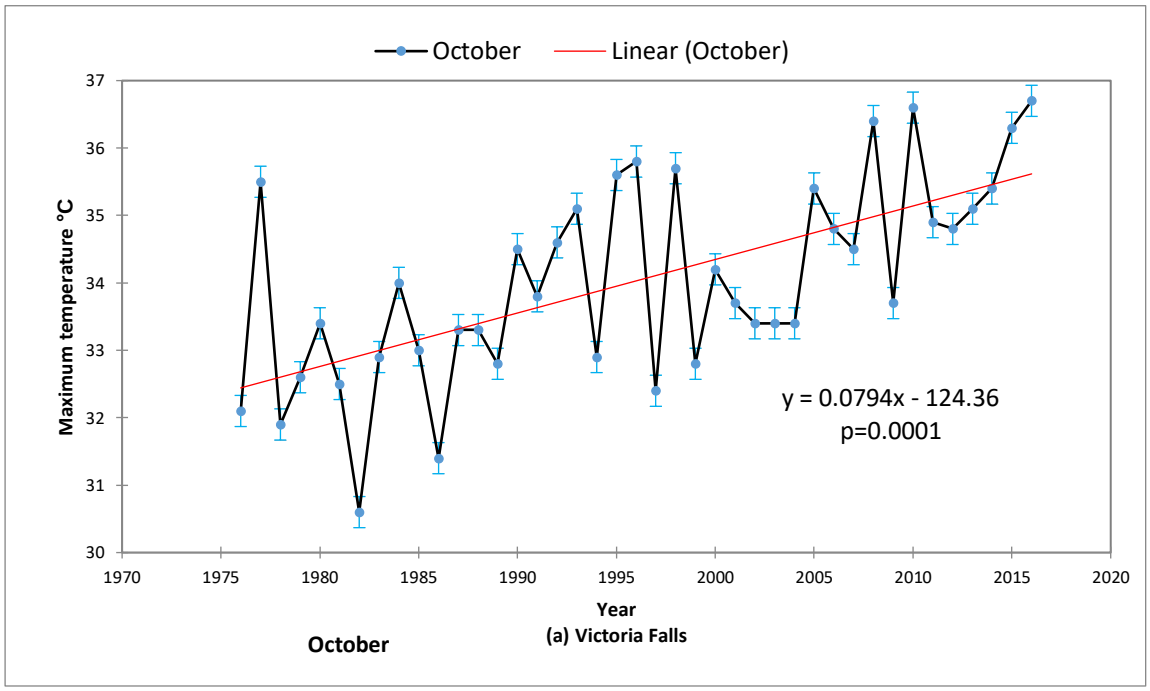
Figure 4.4b: Trends in Livingstone Maximum Temperature (1976-2016)

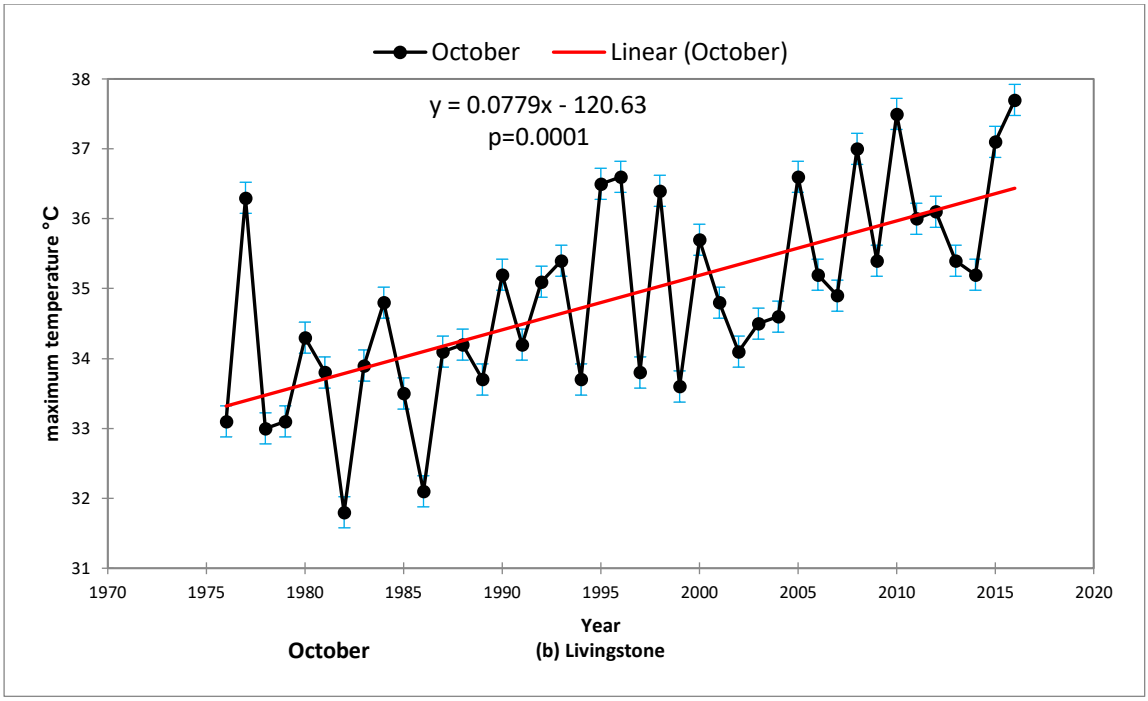


Source: Field Work 2017

October recorded the highest temperature increase which could have contributed a lot to the overall annual growth of temperature at both stations as shown in Figure 5a and 5b. In Livingstone, in 1976 the average maximum temperature was 33.1°C and 35.8°C in 2016 representing a 2.7°C temperature increase over a 40-year period. In Victoria Falls the average maximum temperature was about 32.1°C in 1976, rising to an estimated 35.9°C in 2016. This represents a 3.8°C temperature increase in the 40-year period. The temperature increase is way above current projections and models over the same period for the entire world and the region in question (Section 2.6).

Figure 4:5: October recorded the highest statistical significance temperature increase at Victoria Falls and Livingstone Stations





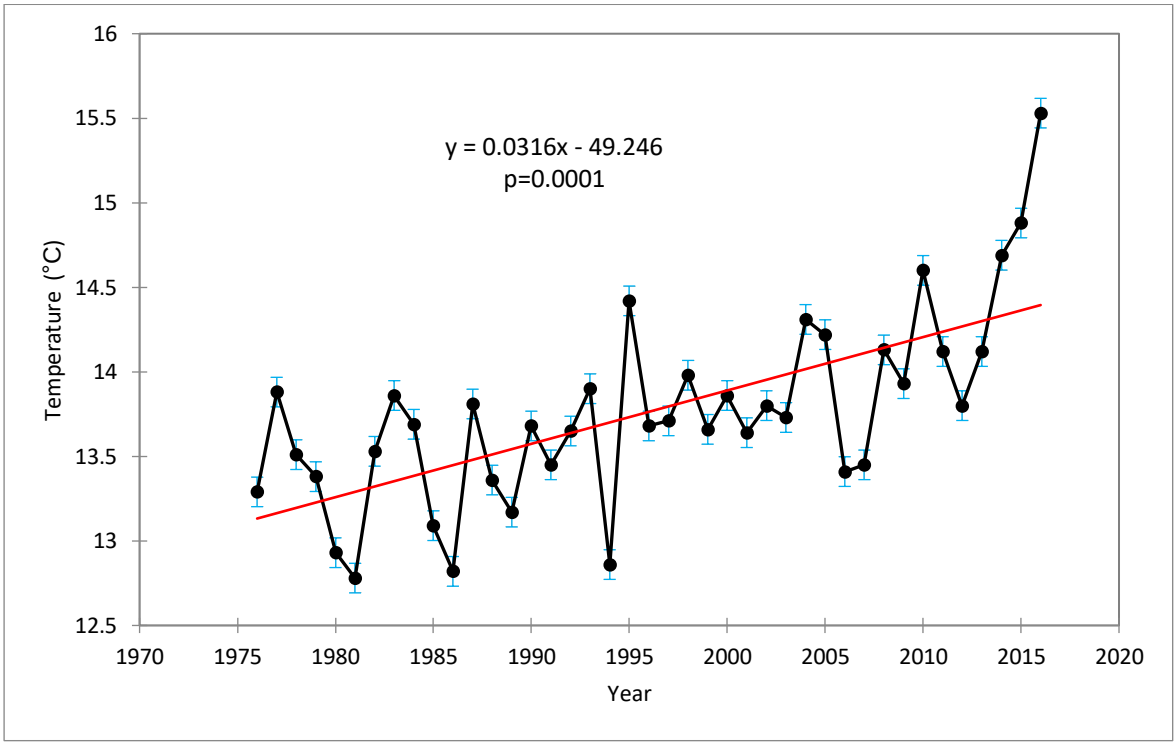
Source: Field Work (2017)

Increased summer temperature in Victoria Falls is likely to lead to increased demand for cooling systems at commercial and residential properties. Since the energy supply is heavily dependent on burning coal, increased energy demand will also result in increased running costs for the tourism industry. Increased energy demands will also increase carbon emissions leading to more global warming that also affect the Victoria Falls. In addition, increased temperature is likely to result in increased evapotranspiration rates which may lead to water shortages for ecosystem services and have a detrimental effect on wildlife and human beings in general. Fire incidences may also be increased as vegetation is dry run up to the rainy season.

4.4 Victoria Falls Minimum Temperature

The annual minimum temperature has been relatively steady over the past 40 years with the noticeable increase being reported around 2014. This coincides with one of the most intense El Niño event in a 150-year history that lasted close to three years on record. Throughout the 40 year history, there was an increase in minimum temperature from about 13°C to about 14.1°C. The trend is also associated with small variability in between the years (Figure 4.6).

Figure 4:6: Victoria Falls Average minimum average annual temperature 1976-2016



Source: Field Work (2017)

Monthly as depicted in Figure 4.7, March, April and May did not show any significant changes over the period in question, although evidence of climate variability is visible between years. There is evidence that winters are becoming warmer and records for winter minimum temperatures and other selected months are presented in Table 4.1. The largest minimum temperature increase was registered in the winter months and in October. As discussed under maximum temperature, the increase in temperature has similar implications for plant cycle, wild animals and human comfort. Given that October has witnessed the triple challenge of declining rainfall, increasing maximum and minimum temperatures this may result in a dried Victoria Falls during this period.

Figure 4:7: Victoria Falls Minimum Temperature (1976-2016)

Source: Field Work (2017)

Table 4.1: Average minimum temperature change for selected months (1976-2016)

Month	Average Minimum Temperature in 1976 ℃	Average Minimum Temperature in 2016 ℃	Average Temperature Change ℃
June	5.9	7.8	1.9
July	4.2	6.8	2.6
August	7.9	8.9	1
October	16	18	2
December	17.9	19.1	1.2
January	17.9	18.9	1

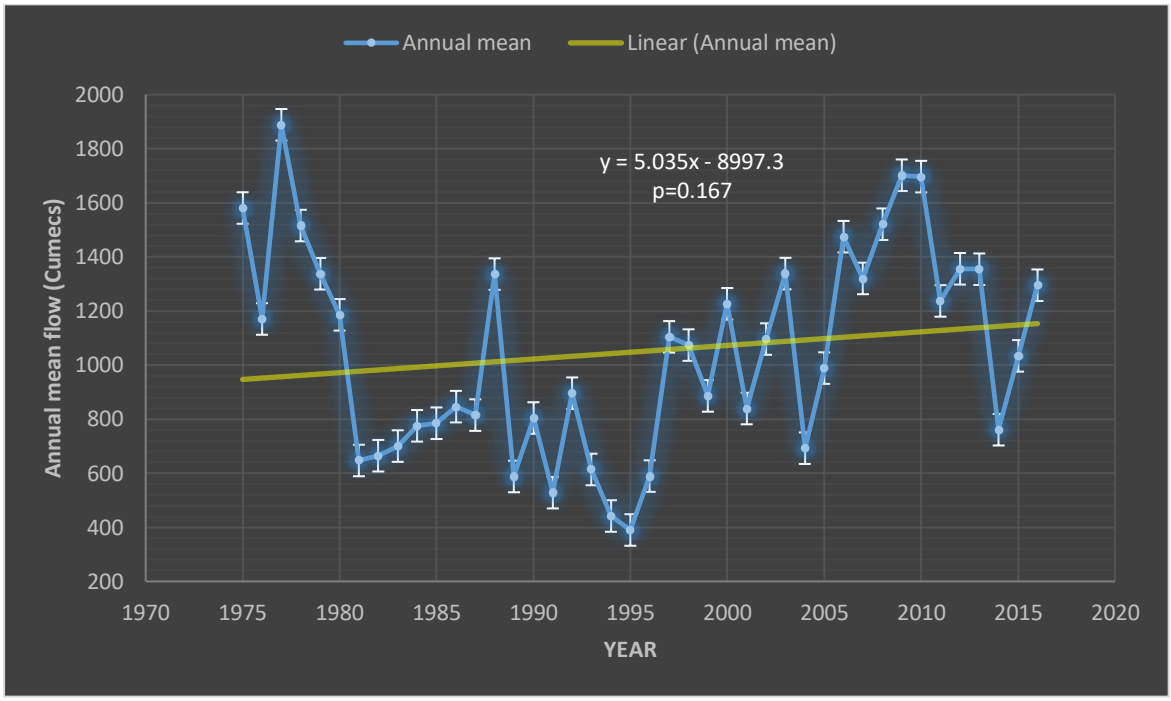
Source: Field Work 2017

4.5 Hydrological Pattern over the years

There has been widespread speculation on social media, blogs, YouTube and other platforms such as state newspapers that the Victoria Falls is either drying up or, has dried up. These claims peaked during the 2015/16 season due to the severe drought that affected most parts of Southern Africa. This perception seems to have been backed by some researchers who predicted a decline in water flow based on models and projections in the Zambezi River as a consequent of precipitation changes in the basin such as Beilfuss, (2012).

A look at the hydrograph data obtained from the hydrograph gauging station located about 50m upstream of where the falls give a picture of what has been happening over the past 40 years. The Victoria Falls hydrography gauging station has the most reliable discharge data in the basin with records stretching as far back as 1907. An annual hydrograph for the past 40 years indicates that there has been a significant increase in water flow over the years. The 40-year annual mean is 1,044m³/s. There were 25 years out of 40 that surpassed the 40 years mean as depicted in Figure 4.8.

Figure 4:8: Zambezi River annual discharge as measured at Victoria Falls Hydrological Station



Source: Field Work 2017

In the decade 2006-2016, only one year failed to surpass the 40 years mean and the 110-year average for the Zambezi River discharge. The year that failed to exceed the two averages was recorded during the 2014/2015 season where 897m³/s has been registered. In the past two decades, only three seasons failed to reach the discharge mean namely 1996/97, 2004/05 and 2014/15. Consequently, there is more water flow in the Zambezi Basin than at any other time in the past 40 years.

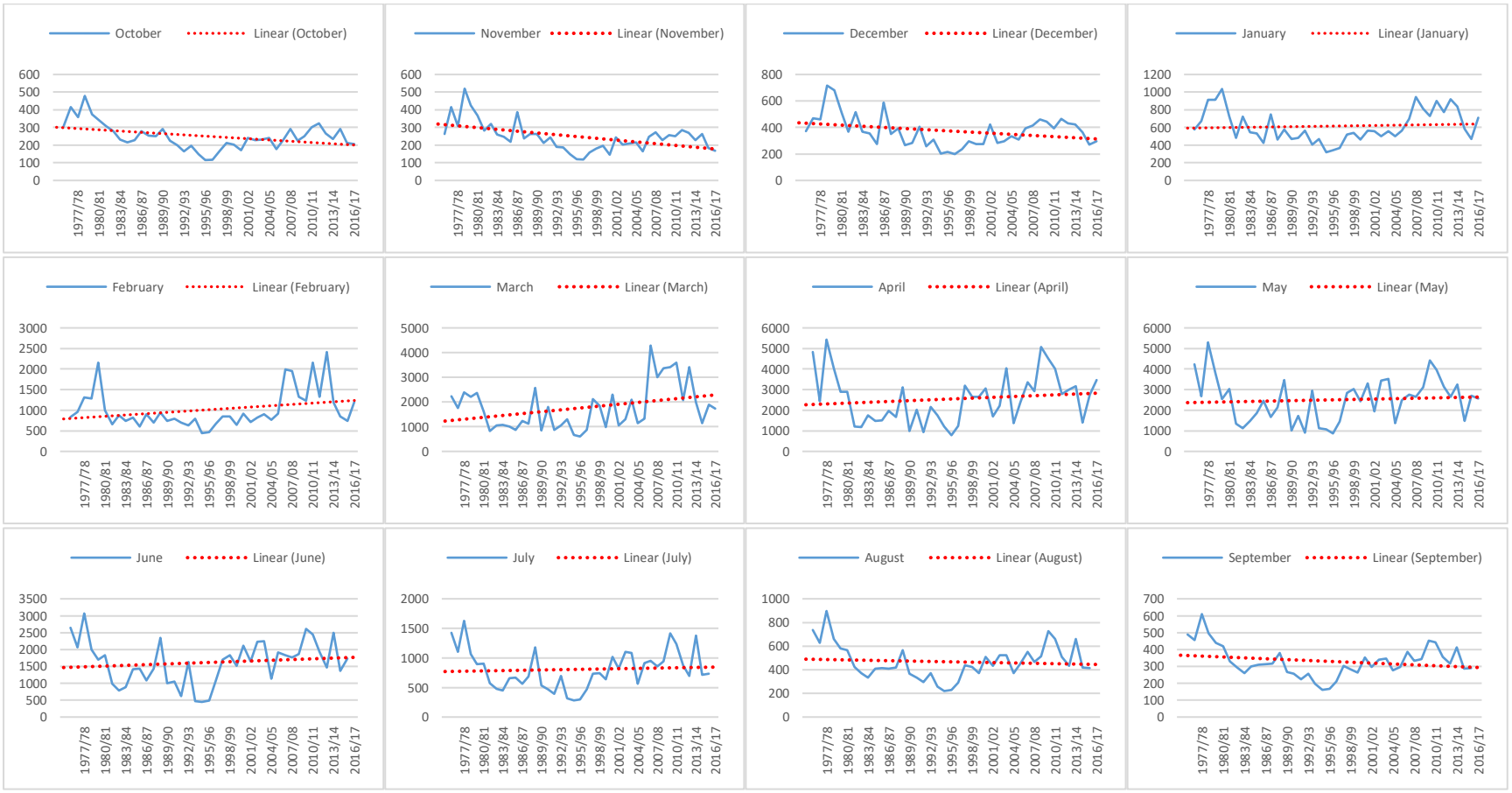
The maximum river discharge at Victoria Falls was recorded in 1957/58 where a total of 8,720m³/s was recorded. The lowest water discharge was recorded in 1995/96 where 116m³/s was registered in October. The second lowest was in October, and November where118m³/s discharge was recorded. The third lowest water flow was recorded in November 1995/96 with a record of 120m³/s.

On month on month basis (Figure 4.9), there have been changes in river flow for most months. January, February, May, June and July recorded a slight increase in their water flow for the period 1976 to 2016. Over the same period, April witnessed a moderate increase in discharge with an average of 2,050m³/s in 1976 going up to around 3,000m³/s in 2016. The increased water flow in the above months can be partly

attributed to the increase in rainfall amounts in January, and April as reported earlier on.

There was a general decline in all the other months. A slight water drop was recorded in August and September. December recorded an average annual drop in water flow of about 100m³/s from the flow rate of slightly higher than 400m³/s in 1976 to around 300m³/s in 2016. October also witnessed a similar water flow drop with a flow rate of below 300m³/s in 1976 to slightly over 200m³/s in 2016. November had the largest drop in water flow starting at over 300m³/s in 1976 dropping to below to 200m³/s in 2016. Consequently, the lowest water levels at Victoria Falls are recorded between October and November. The drop-in discharge in October and November could be partly due to delay in the onset of the rainy season and reduced infiltration in the basin due to natural and human influences during the rainy season leading to reduced ground recharge.

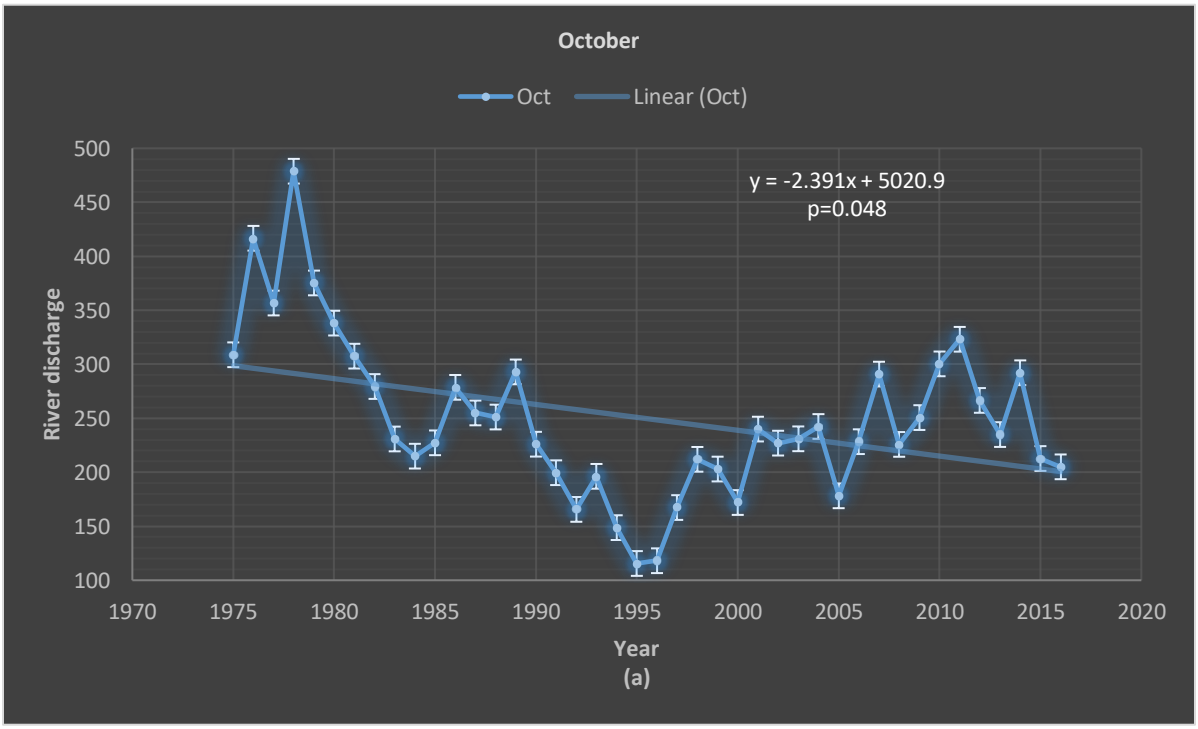
Figure 4:9 Monthly discharge m³/s at Victoria Falls Station in 1976-2017

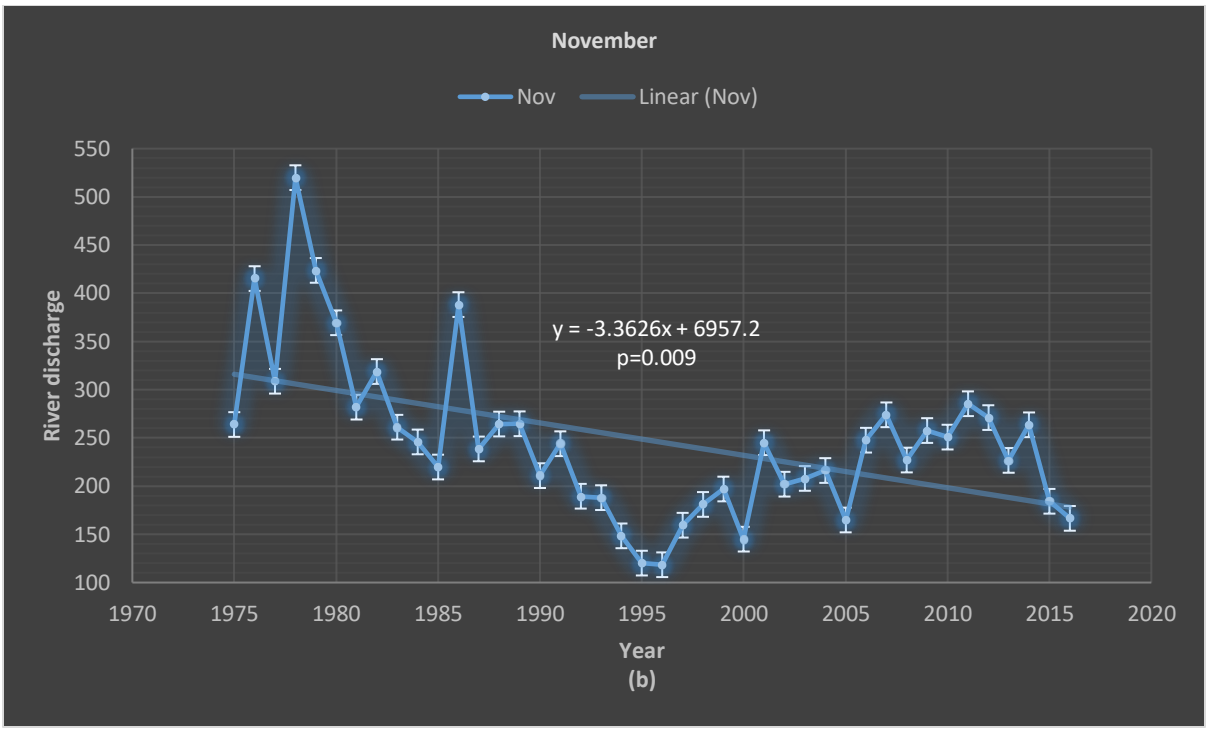


Source: Field Work (2017)

Tourists visiting the falls during October and November must expect to see very little water flow at the falls with some parts of the falls having no water at all, especially on the Zambian side. A graphic pull-out showing the statistical significance of water flow change in November and October which could be partially attributed to climate change is shown in Figure 4.10. During this time, most tourists will see lots of exposed islands. However, adventure tourists can enjoy and participate in activities such as swimming at the devil's pool as temperatures are very high during that time of the year. Watersports such as white-water rafting are enjoyable as water levels will be low and temperatures high enough to allow for water activities.

Figure 4:10: October and November Recorded the most significant drop in water flow between 1976 and 2017



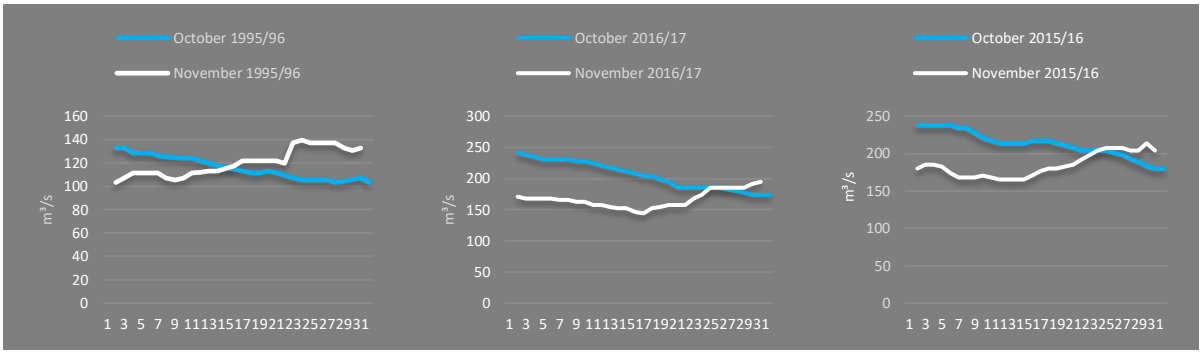


Source: Field Work (2017)

The month of April marks the peak discharge of the waterfalls followed by May. Tourists visiting the falls at that time expect to enjoy the Victoria Falls' full spray. However, due to high volumes of water discharge tourists might not be able to take beautiful photographic pictures from the ground and might want to bring along waterproof cameras to take pictures or resort to aerial helicopter flights to take pictures from the air. Most islands are completely covered in water and activities such as white-water rafting are most likely closed. Tourists planning to go swimming at the devil's pool on the Zambian side will not be able to do so as water levels are too high at this time.

To answer the question on what happened in 2015 and 2016 that sparked the outrage on the drying up of the falls, a daily flow analysis was conducted to get a clear picture of the ground conditions on each day that sparked the outrage on social media and news media outlets. The data was compared with the year and month were the lowest water levels were recorded as shown in Figure 4.11.

Figure 4:11: Daily Average Flows m^3/s



Source: Field Work 2017

Hydrographic evidence points out that the lowest flow rate even on a daily rate was recorded in 1995/96 on the 27th and the 31st of October where the daily discharge fell to 103m³/s. The outcry in 2015/2016 and 2016/2017 rain season were therefore not the lowest levels in history. The discharge for the two periods was 213³/s and 184m³/s for October and November 2015/2016 respectively, and it was 205m³/s and 184m³/s for October and November 2016/2017 respectively. While water levels were low, there is a chance that human memory may not have remembered what happened 20 years back. Also, the science of climate change was still being contested in these years as the global consensus was reached through the AR4 report in 2007. As such, the significant historical low discharge may have gone without much publicity in the context of climate change. Hence the increased awarenesses and concern over climate change and access to social media could have perpetuated the media storm. This could also have been due to increased access and use of social media.

It is also important to note that although there is an annual increase in the water flow discharge at the Victoria Falls gauging station, there is growing evidence that the water flow is quickly dropping to unprecedented low levels in October and November. This could be due to a number of factors, among them the short rain season as noted in the section on rainfall pattern. Increased discharge can further be attributed to land-use changes such as deforestation, agriculture and urbanisation that led to reduced underground recharge of water and increased runoff upstream of the Zambezi River basin. The sharp decline after peak discharge can also be attributed to increased evapotranspiration in the

basin as a consequence of increased temperature due to global warming and extreme rainfall events. Kling et al. (2014), noted that the evapotranspiration rates in the Zambezi basin between October and December was so high and resulted in delays in actual discharge in the river at the beginning of the rain season (Section 2.6). High evaporation rates and ground recharge are responsible for the delay in the river reaching its peak discharge. The peak discharge seems to be only reached at the end of the rainy season when precipitation have exceeded evapotranspiration and infiltration rates.

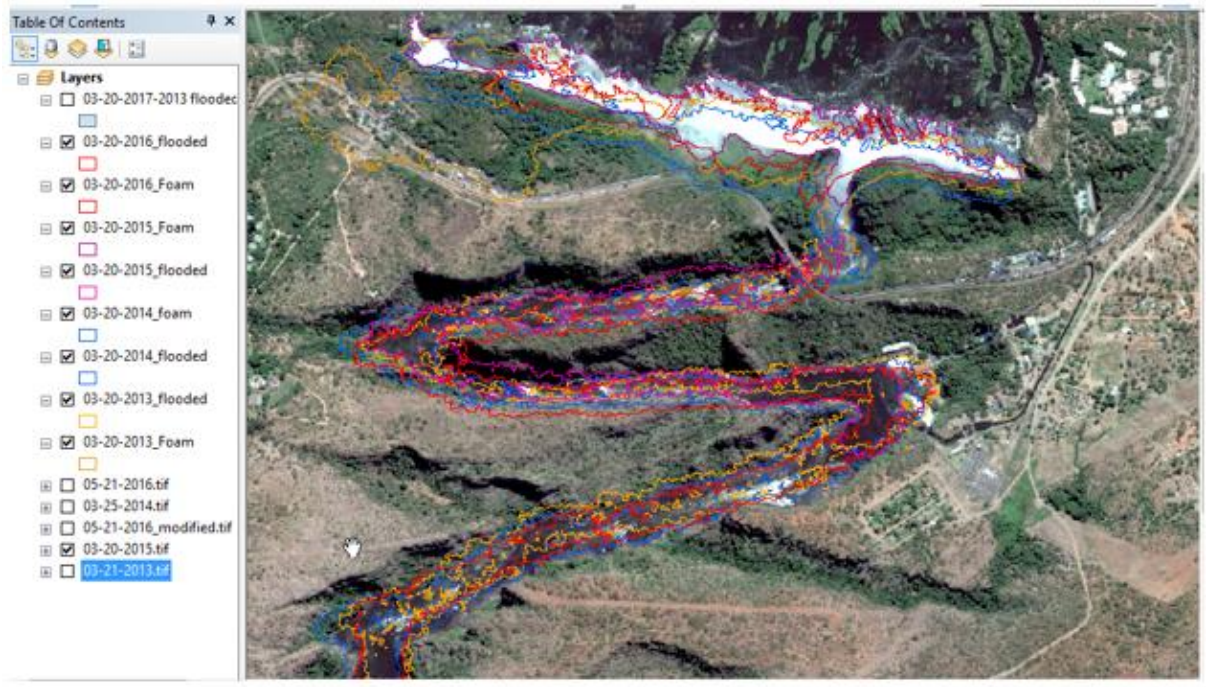
The tourism players in the Victoria Falls who are cautious of the severe river fluctuations have in the past few years started implementing rudimentary work to measure and record the river flow regime about five kilometres above the Victoria Falls. The project to measure the water level and or flow patterns by a certain boating company on the Zimbabwean bank of the Zambezi River confirms the annual variations in the river's water levels and/or flow pattern. Figure 4.12a&b shows the hydrological pattern pointing out the continued recession of water levels over the past five years.

Figure 4:12: River Level Measurements by a boating company along Zambezi River

Source: Fieldwork 2017

There is a marked distance between 2010, 2009 and the rest of the pegs which marks other seasonal year pegs owing to substantial discharge variations. The drop in water levels is widely attributed to climate variability over the past eight years, as noted from other data sources. The changes in water flow pattern are also evident at from the Google Earth images of the Victoria Falls that were analysed to monitor flood detection over 2013 and 2016 (Figure 4.13). The exercise aimed to gather data on water fluctuations on a particular day at the Victoria Falls.

Figure 4:13: Google Earth images: Map overlay showing evidence of climate variability at the Victoria Falls waterfalls for March 2013-2016.



Source: Field Work 2017

A flood destiny matrix taken at the waterfall between 2013 and 2016, shows that there has been variation in water flow at the waterfall at the time in question (Table 4.2).

Table 4.2: Flooded area size metrics for 20 March at Victoria Falls 2013–2016

Year	Edge Density (ED)	Mean Patch Fractal Dimension (MPFD)	Total Area (TA)
2013	7817 m	0.2785	25.8600 ha
2014	2815 m	0.4194	25.8600 ha
2015	5320 m	0.4141	25.8535 ha
2016	5315 m	0.3526	25.8473 ha

Source: Field Work (2017)

A reading of Figure 5 together with Table 4.2 shows that the highest flooded area density for the four-year period was recorded in the 2012/13 rainfall season, while the lowest was recorded in the 2014/15 rainfall season, which coincides with the maximum and minimum

rainfall received during the same period. The MPFD further verifies the findings as they are highest and closer to one in 2014 and lowest in 2013. It can, therefore, be concluded that based on the results there is a spatiotemporal variation area and foam size for the year size. Such variations have the potential to reduce the attractiveness of the waterfalls as in 2014 and 2015 there was a social media outcry because the waterfalls were drying up. This is the same period that southern Africa was affected by one of the severe El Niño droughts in history which were largely believed to have been worsened by climate change (Funk et al., 2016). Although the total drying up of the falls may be far-fetched, evidence from pictures taken by tourists, climate data and hydrology data show that climate change is indeed a real threat to the predictability of flow patterns at the Victoria Falls World Heritage Site. Extreme weather events have the potential to disrupt the tourism industry, and the impact of such extremes depends on the severity and frequency of such occurrences.

The changes in water flow pattern are also evident in the falls at Victoria Falls when one looks at images from Google Earth. The images show that the water at the Victoria Falls especially in the last episode of one of the most severe and prolonged El Niño drought in history. As a consequent, the islands and most sections of the falls were depleted of water with only small sections with patchy water seen. This is worrying as the impacts of climate change are predicted to worsen going forward. Although the total drying up of the falls may be far-fetched, evidence from pictures taken by tourists, climate data and hydrology data shows that indeed climate change is a real threat to the predictability of flow patterns at the Victoria Falls World Heritage Site.

4.6 Climate Change Implications for the Victoria Falls

Based on the findings from this chapter, a new climate table 4.1 is proposed for the Victoria Falls based on data for the past 41 years (Table 4.2). A combined and updated climate and hydrography are essential as it guides the tourists on the kind of weather to expect at various times of the year as most tourism activities are dependent on weather and hydrograph of the Zambezi river.

Table 4.3: Average Victoria Falls Monthly Climate Weather Chart and Flow Hydrograph

month	*January*	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct*	*Nov*	*Dec*
Min℃	18	18	17	14	10	6	6	8	13	17	18	18
Max℃	30	30	30	29	28	25	25	28	32	34	33	31
Rain (mm)	174	123	88	19	6	3	0	0	4	20	70	163
Hydrograph m³/s	616	1018	1770	2553	2508	1616	807	467	330	250	247	373

Source: Fieldwork 2017

4.7 Chapter Conclusion

The Chapter was aimed at examining evidence of climate variability and change in Victoria Falls. An analysis of climate and hydrological records over the past 40 years show evidence of climate variability and change in the area with a statistically significant annual increase in water flow at the waterfalls. Regarding rainfall pattern, there have been slight annual changes in average rainfall which are insignificant although rainfall season shifted and its much shorter. There is also proof of climate variability and extreme rainfall pattern that is marked by intense rainfall in some years and extreme aridity in other years. There has been a stronger leaning towards increased drought years in the recent past due to increased incidence of El Niño, and La Niña phenomena attributed to climate change. The research found out that there are marked delays and shortening of the rainy season, which was previously running from November to April and now running from October to April with increased rainfall amount in November, January, and April. In addition, the temperature for Victoria Falls resort town has significantly increased over the years with the marked increase being recorded in October and November which accounts for the larger portion of temperature increase. Trends of winter warming emerged as winter months particularly June recorded a significant increase over the past 40 years. Changes have implications for wildlife, tourists and tourist activities in the resort town.

There is evidence showing that there is increased water discharge at the falls, particularly in April and May. However, the peak discharge period is now shorter with some months recording lower than usual discharge notably in the months of October and November. To this end, there is a chance that these months may witness a dried-up fall given that the rainfall has been reducing drastically, with increasing maximum and minimum temperature. This scenario confirms the social media outcry of 2915/16 that the falls were drying up. Given the evidence of climate variability and change, there is an extension of activities like white water rafting and swimming at the Devil's Pool. There is also the shortening of specific activities like falls viewing in full discharge. Furthermore, warmer winter months will likely reduce energy demands, while warmer summer months may result in increased energy demands which in turn increase carbon emissions that lead to global warming and climate change

Chapter 5 : Tourists Perceptions on and Attitudes Towards the impacts of climate change

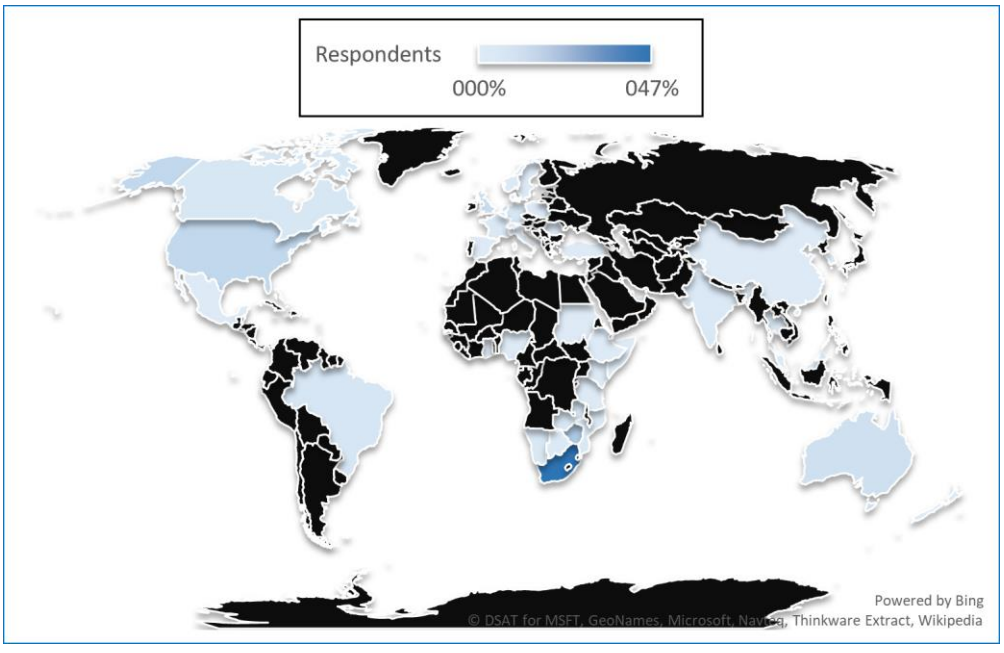
5.1 Introduction

This chapter deliberates on tourist perceptions on, and attitudes towards climate change and variability in the Victoria Falls. The findings are based on a nine months online survey conducted between November 2016 and August 2017 as well as social media content review. The chapter addresses the third research objective that sought to establish perceptions on, and attitudes towards the impacts of climate change on Victoria Falls. The data sets utilised were gathered from tourists across the world. Perceptions are critical as they drive the tourism industry and inform the way people deal with issues on a daily basis.

5.2 Profile of respondents and Reasons for Visiting

The survey was completed by 370 tourists (see the area in blue in Figure 5.1 that shows countries where respondents were drawn from).

Figure 5:1: Online Survey Response Distribution Map (n=370)

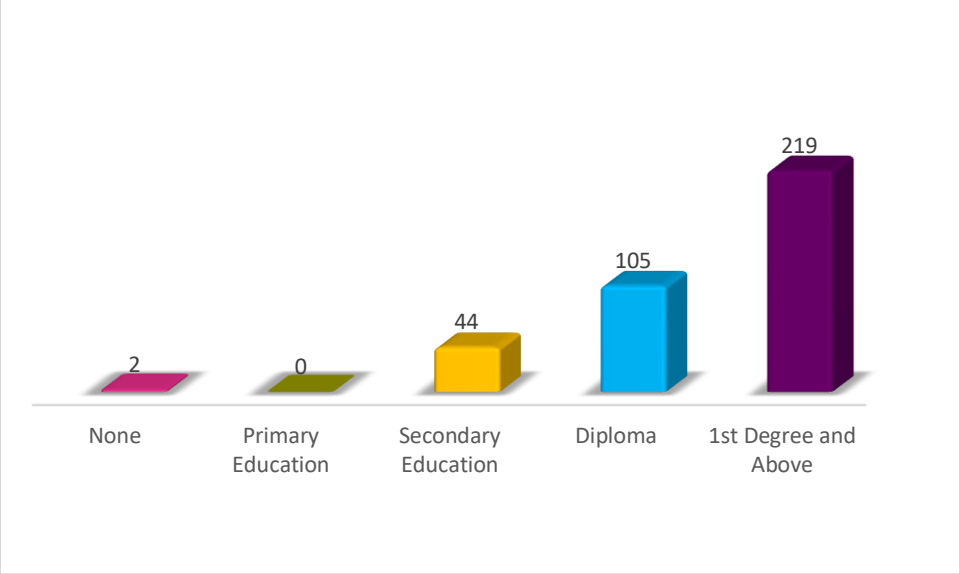


Source: Fieldwork 2017

From Figure 5.1 it emerges that respondents were from about 43 different countries across all the seven continents. As South Africa is Zimbabwe's tourism biggest market, most respondents equally came from South Africa where 47% of respondents came from followed by the Zimbabwe market (13%), the United States of America (7%), the United Kingdom (6%) and Australia (4%).

The survey had the high participation of educated people with the expectation that they would have some level of knowledge on climate change which will assist in the study. About 80% of the respondents had attained tertiary qualifications, with 60% of that population being holders of first-degree qualifications and above as shown in Figure 5.2.

Figure 5:2: Education Profile of Respondents (n=370)



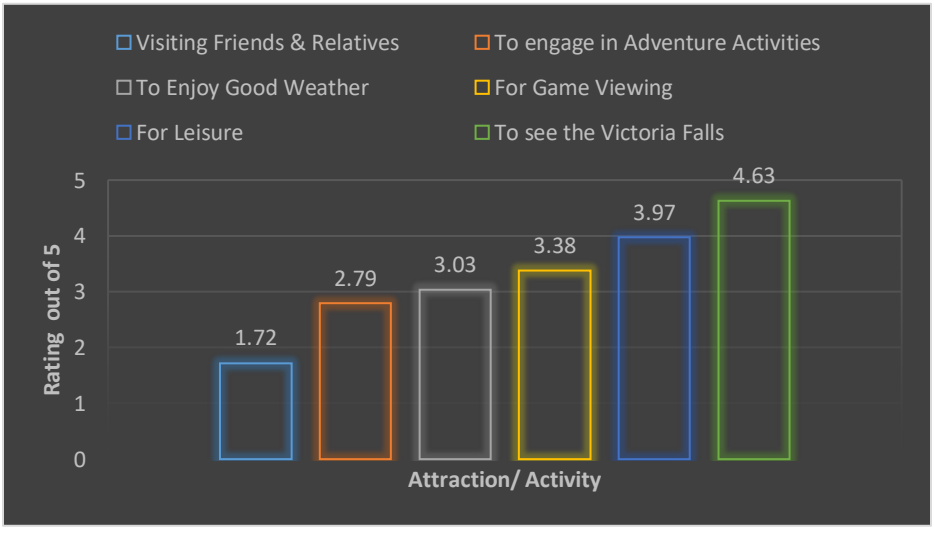
Source: Fieldwork 2017

The profile of respondents attests to the long-held view that by profile eco-tourists are educated individuals who are informed, knowledgeable and well-travelled individuals with a deep understanding of the tourism products. A similar profile was observed for ecotourists elsewhere in the world and regionally (Nheta et al., 2017). The huge participation of educated people was seen in good light as it means that to some extent the participants have a level of understanding of the research focus.

From the survey, it emerged that 34% of the respondents were first-time visitors to Victoria Falls and the remaining 66% had visited the resort town more than once. Out of the repeat visitors, 35% had visited the Victoria Falls more than three times. This shows how popular the attraction is with the tourists. Tourists indicated that they repeatedly visit the resort numerous times to view it in various seasons and during the experience enjoy the various seasonal activities that the destination has to offer. Whitewater rafting and swimming at the devil's pool are conducted during the low water season whereas other activities such as rainwater walking, lunar rainbow views are best during the high-water flow season. Repeat visitors are central to the research as some questions required articulation of changes over time. At least 66% of the respondents, therefore, can be said to be knowledgeable about the resort given that they are repeat visitors to the destination. It is important to note that repeat visits tend to create an emotional bond with the attraction.

It is imperative to understand tourists' motivations for travelling as climate modification of the aspects of the resort can affect tourist flow either positively or negatively. Tourists were asked to rate the primary reasons for visiting the Victoria Falls. Figure 5.3 shows the rankings for visiting the Victoria Falls one being the lowest rank and five highest ranking.

Figure.5:3: Reasons for Visiting Victoria Falls



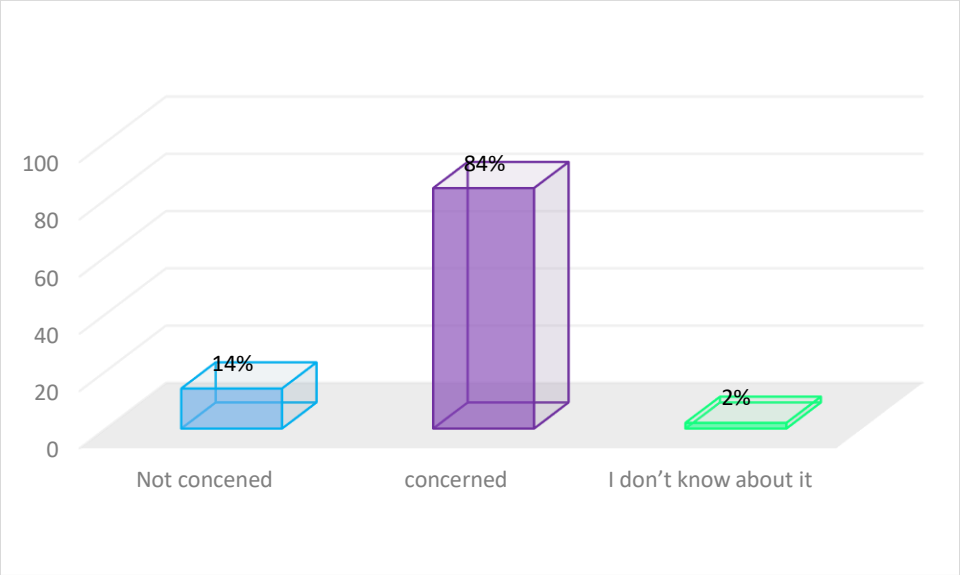
Source: Fieldwork (2017)

The study revealed that most tourists consider visiting the waterfalls as the most important reason for visiting the resort town of Victoria Falls. The second-most important reason for visiting the Victoria Falls resort town was for leisure and recreation purposes. Tourists also consider the destination to be a luxury destination where they go to relax. The third-most important reason for visiting is to participate in game viewing. Field observation revealed that the Victoria Falls is in a predominantly wildlife area with national parks and game reserves being the principal land use in the area. Adventure activities were also cited as an essential reason for visiting. Victoria Falls is fast gaining the status of an "adventure capital of Africa" as it offers quite a number of adventure activities which are popular with tourist such as white-water rafting, bungee jumping, flying fox, elephant rides, zip line, gorge swing and lion walk to mention but a few

5.3 Tourists Attitudes towards Climate Change

When tourists were asked about whether they were concerned about climate change most tourists indicated that they are concerned about climate change and its implications for the tourism sector in general. About 84% of the respondents expressed concern and fears that climate change may have a negative impact on Victoria Falls, while 15% of tourists indicated that climate change is not a concern. Climate change concern is said to be a factor of five aspects namely: exposure to extreme weather events, public access to accurate climate change information, coverage of climate change issues by media, elite cues and advocacy by pressure groups (Brulle et al., 2012). The level of concern amongst tourists is higher than the average global concern of climate change which is set at 51% (Pew Research Center, 2015) and much higher than most individual countries where respondents came from. A tiny fraction of tourists (2%) indicated that they were not sure of what to make about climate change as a concern as shown in figure 5.4. The high level of concern could have been fuelled by speculation that the Victoria Falls is drying up as a consequent of a severe drought that affected parts of Southern Africa between 2014 and 2016. Font and Hindley (2017), noted that threat of climate change concerns by tourists could be explained through the reactance theory as tourists fear that climate change will adversely affect the freedom to freely move which triggers higher levels of concern for climate change amongst tourists.

Figure.5:4: Climate Change level of concern amongst tourists



Source: Fieldwork 2017

Understanding tourists concern regarding climate change and its impacts are crucial Walters et al. (2014), pointed out that disasters such as those induced by climate change have potential to threaten destination sustainability and pose significant challenges for marketers. Perception of risk whether real or does not affect the decision by tourists to visit or not to visit a destination. On the other hand, a concerned tourist is more likely to take steps to address climate change or to want to participate in adaptation and mitigation strategies to reduce the impact of climate change than an unconcerned tourist. Since most tourists are concerned about climate change, it hopefully provides an opportunity to use tourists as change agents in the tourism sector and the broader community in addressing climate change.

Helm et al. (2018), noted that a study of the psychological impact of climate change had revealed that there were three groups of people they identified who responded differently to climate change namely: (i) individuals in higher biospheric concern. These were concerned about the perception of climate change occurrence and engaged in ecological coping strategies, (ii) individuals higher in social-altruistic concern. These individuals did not show concern nor were they stressed by perceived climate change but they responded by engaging in ecological coping strategies and lastly (iii) a group of higher

egoistic individuals who were neither concern and never engaged in ecological coping strategies.

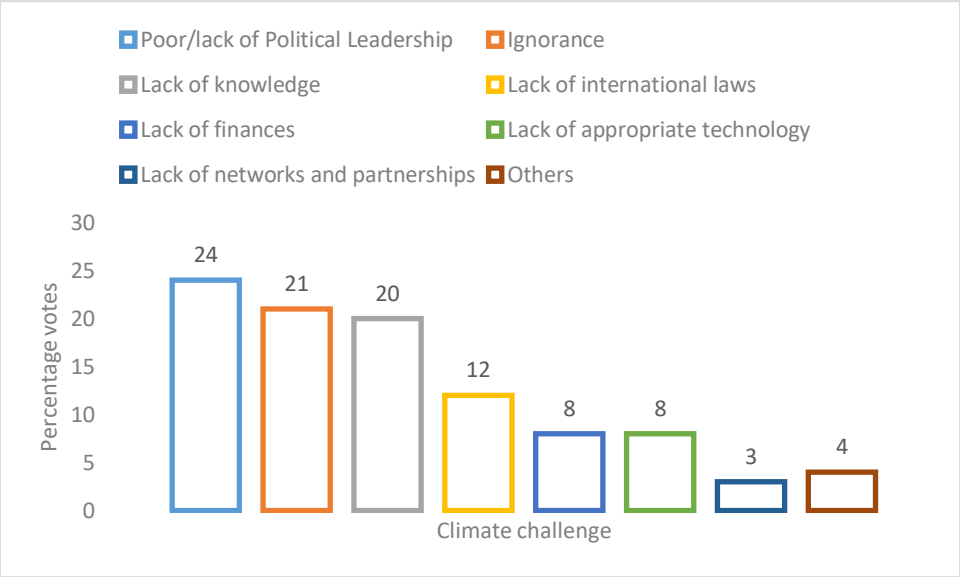
When tourists were asked to give an opinion on the cause of climate change, the majority were unequivocal in pointing out that climate change was anthropogenically driven. To that effect slightly more than two thirds (67%) of the respondents attributed climate change to human activities. However, slightly less than one-fifth of respondents believed climate change is a naturally driven process that follows certain natural cycles. A tenth of the respondents believed that climate change is a result of a combination of human and natural factors. None of the respondents to this question indicated that they do not believe in climate change. The results indicate therefore that the majority of ecotourists to the Victoria Falls are knowledgeable about the causes of climate change. Results indicate a growing knowledge amongst tourist of the understanding and the underlying debate on the causes of climate change in general.

Tourists were also asked to outline the top challenges in tackling climate change. As such, they were asked to choose what they consider to be the top three out of the eight challenges that were identified with an option of an add-on other challenges of their choice. Most respondents noted that the top three challenges of dealing with climate change are weak/lack of political leadership (23%), ignorance (20%) and lack of knowledge (19%). The results, especially on the lack of knowledge, attest to assertions in the Fifth Assessment Report (AR5) as it indicates many areas where knowledge confidence level is still low. Hoogendoorn and Rogerson, 2016 and Scott et al., (2016), among others, pointed to climate change knowledge gaps, particularly in the tourism sector.

The findings on the lack of political leadership confirm what the United Nations Framework and Convention on Climate Change (UNFCC) Conference of Parties (COP) points out. COP is usually characterised by political bickering by global leadership and ignorant utterances by some leaders which has led to a standoff between the Donal Trump and the other world leaders. The ignorance amongst political leadership might be an act of pretention by some global leaders. In position four (13% of responses) cited the

lack of international laws to deal with climate change challenges. The findings resonate with common knowledge that 25 years post the Earth Summit which paved the way for UNFCC the world still does not have an international binding law on climate change. Those who chose 'others'' indicated that, where such laws are in place, such laws were not being enforced or adequately applied. Some tourists felt that the growth in human population, lack of political will and lack of sense of urgency as undermining factors in decisively dealing with climate change. Figure 5.5 depicts some of the most common problems that were identified in dealing with climate change.

Figure 5:5: Top challenges in addressing Climate Change

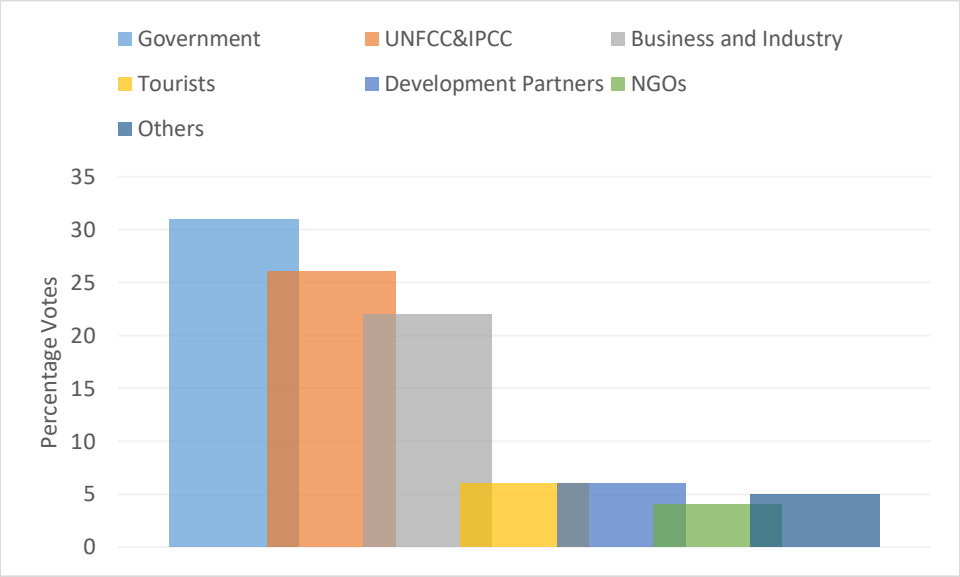


Source: Fieldwork 2017

Tourists further gave insights as to whom they feel should be responsible for dealing with the problem of climate change. About a third of the tourists opinionated that dealing with climate change was a prerogative of the government, while about one in four tourists believe that it is the role of UNFFCC and IPCC's to deal with climate change. About one in five tourists believe that business and industry must deal with climate change as shown in Figure 5.6. Considering the results, the role of the IPCC and national governments in shaping the climate change agenda can never be overemphasised, and the global citizenry expects real action from the annual Conference of Parties. It emerged from the results that most tourists dissociate themselves from the responsibility of climate change

as slightly more than 5% accepted to shoulder climate responsibility. This confirms findings by Whitmarsh (2008:401) who argued that "there is a tendency by the public to dissociate themselves from the causes, impacts, and responsibility for tackling climate change/global warming."

Figure 5:6: Who is responsible for dealing with climate change? (N=947)



Source: Fieldwork 2017

The majority of the 5% that chose the 'other' option highlighted that tackling climate change demands combined effort amongst stakeholders. A minority of those expected the Western countries to take a leading role in this regard as they were perpetrators of climate change through industrial activities. The high resource consumptive lifestyle and industrialisation was also blamed for causing climate change in many respects (Wolf et al., 2009).

Considering the results, one may, therefore, assume that tourists expect governments to take a leading role in championing climate policy formulation, research and enforcement and lead in green tourism initiatives for adoption. Other bodies such as the UNFCC and IPCC need to provide better access to information and research on climate change to all people across the world. To tackle climate change, there is a need to force government and political leadership to coordinate global citizens and rally them into climate action

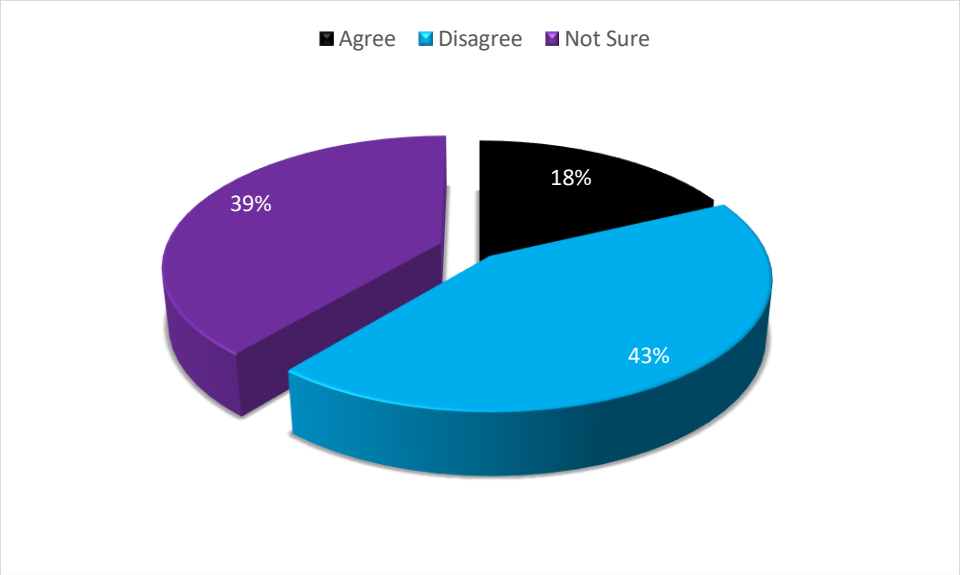
which at most is lacking (Ross et al. 2016). This information must be in a manner that is simple and easy to understand. While climate change has been a central issue that dominates general election in other countries, there is a need for global citizens to hold political leaders accountable with regards to decisions they make pertaining climate change and other environmental issues.

5.4 Perceived Impact of Climate Change on Victoria Falls

As indicated earlier, perceptions drive the tourism industry. In 2014 and 2015, there was a media scare that Victoria Falls was drying up on social and print media. To this end, the survey asked tourists to give opinions on the likelihood of Victoria Falls waterfalls drying up. The tourists were largely split on this question with no clear majority opinion on the matter. The results show that the dominant opinion was that the Victoria Falls would unlikely dry up (43%). At least about two in every five tourists (39%) were not sure as to how climate change will affect the water flow at the Victoria Falls waterfalls. This indecisiveness could be attributed to highly unpredictive weather pattern in the valley, which has seen some arid years and some years being extremely wet with the flow pattern at the Victoria Falls resort following these extreme climate fluctuations.

General Circulation Models are widely known to fail to predict future climate for Southern Africa accurately. Available research had also been giving conflicting information making it difficult to understand and predict the future of future basin climate for example (Kusangaya et al., 2014). Several predictions have been made that the Zambezi River would decline by between 20 and 30% due to decline in rainfall. However, studies carried on various rainfall station in the basin has not been able to detect statistical significance of rainfall change within the basin although high annual variability has been witnessed (Kusangaya et al., 2014). A small number of tourists believed that water flow was to an extent a factor of geological processes and the fear that changes in geological dispositions could affect water flow in the basin apart from changes in precipitation patterns. Some tourists who said they are not sure indicated that there was a lack of scientific data to provide a clear picture of what is going to happen shortly or in the long run. Figure 5.7 shows that one in five tourists felt that the Victoria Falls resort was indeed going to dry up because of climate change.

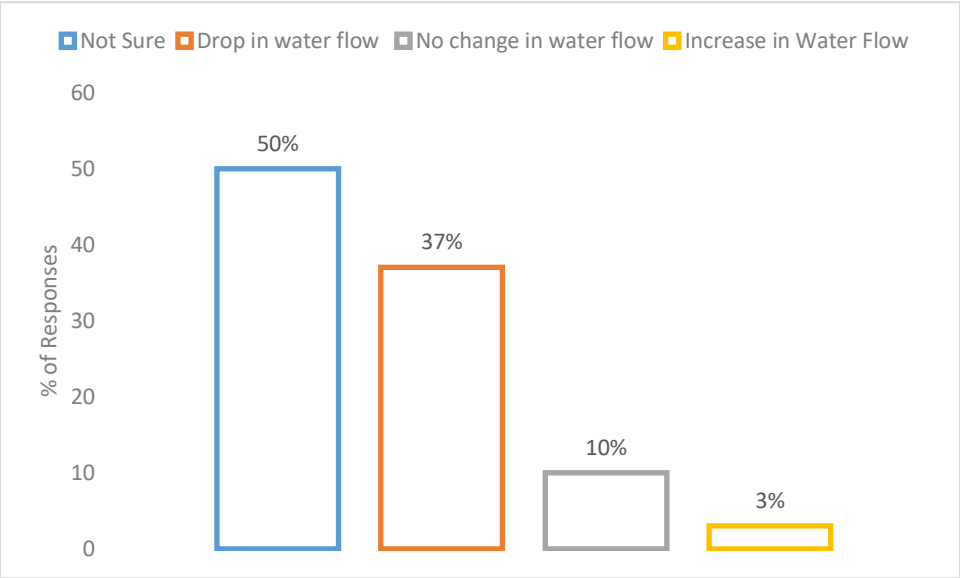
Figure 5:7: On the Prospects of Victoria Falls Drying up



Source: Fieldwork (2017)

Tourists were asked to give an account of their observations at the Victoria Falls resort with regards to water flow at the waterfalls. There was no apparent majority of opinion on this matter with half of the respondents to this question noting that they were not sure if the Victoria Falls was drying up or not (See Figure 5.8). About every two in five tourists had observed a drop-in water flow at the resort attributed to climate change. About one in ten ecotourists noted that they had not observed any changes in water flow at the waterfalls during the various visits they had made to the resort. About 3% of respondents reported that they had witnessed water increase over the years at the waterfalls. About one in every two tourists noted that they were not sure as to whether they had observed an increase or decrease in water flow. The high level of uncertainty could be attributed to the fact that tourists could have visited the waterfalls at various seasons namely the high water, low water or mid-season. Most tourists indicated during the research that they do repeat visits to view the Victoria Falls resort during different seasons to enjoy the episodic activities each season has to offer. Most importantly given the annual variation in water flow due to extreme years of drought and wetness it is equally difficult for a tourist to tell the trend as noted earlier on.

Figure 5:8: Perception of waterfalls flow pattern at Victoria Falls (n=359)



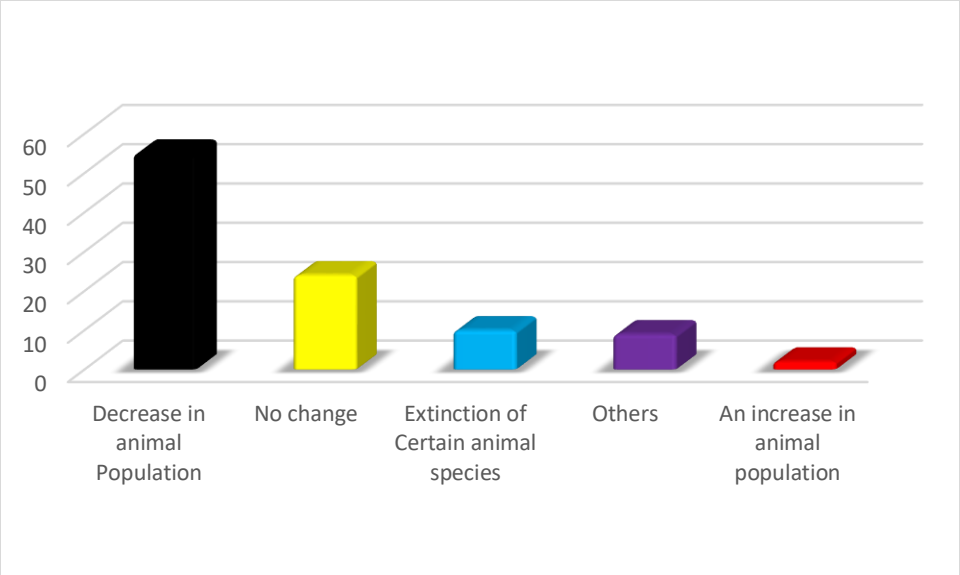
Source: Fieldwork 2017

One of the principal reasons for visiting the Victoria Falls town was noted to be game viewing. As such tourists were asked to report any changes they had observed in national parks with regards to wildlife. Results in Figure 5.9 shows that more than half (55%) believed that there was a decline in animal population. About one in ten (10%) believing that at least some of the animals had become extinct in the area. Almost one in four of the tourists reported that they had not witnessed any changes in animal population in the area. This could be due to lack of interest in wildlife in the area with focus fixated on the waterfalls and other activities. Mapira (2018), and Kupika and Nhamo (2016) seem to confirm some tourists observations by pointing out that climate change and poaching had led to habitat loss which resulted in animal population reduction in many Zimbabwe National parks. One of the factors that could be leading to this decline is reduced primary productivity as a consequent of droughts and increased poaching in the area. Other factors that were cited by people who chose the others option was that they had observed an increase in human and wildlife conflict.

A decrease in animal population in the area could potentially affect the quality of the tourism product in the Victoria Falls given that tourists consider it an important drawcard to the resort area. Nhamo and Mjimba (2017), argued that climate change could prove

drastic for wildlife and result in disturbance of the tourism economy in countries such as Kenya and Zimbabwe.

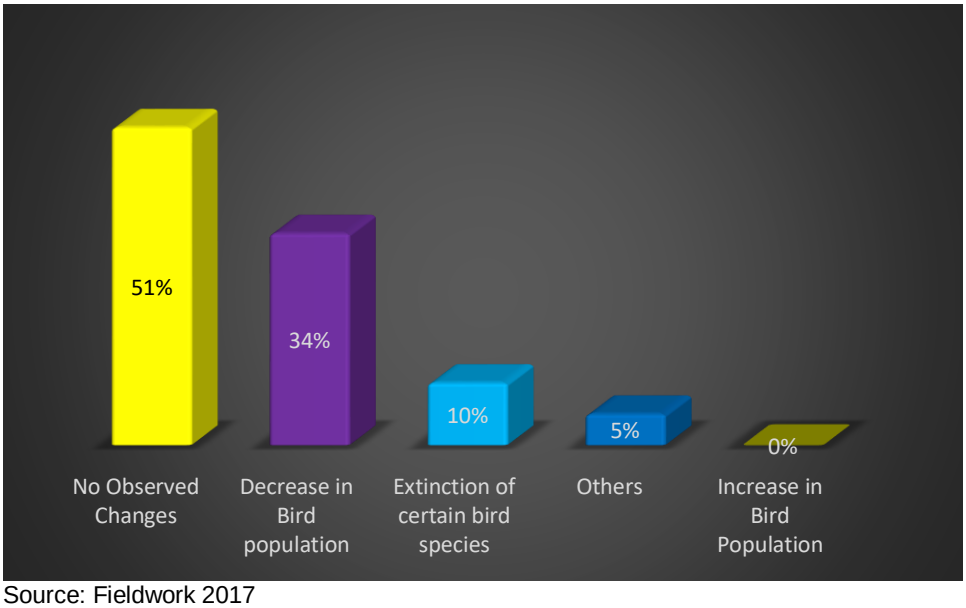
Figure 5:9: Perceived Impact of Climate Change on animal Population (n=370)



Source: Field Work (2017)

The Victoria Falls is categorised as a wetland and a Ramsar site which plays home to some world endangered birds. Victoria Falls is touted as one of the best birding destinations in Africa given the fact that it is located along the Zambezi River (Gray, 2007). Field study indicated that it boasts of more than 500 bird species, which is about 5% of global bird species. It is equally a critical migration corridor for birds with the summer being the ideal time for avi-tourism for both beginners and experienced birders. Some of the endangered bird species use Victoria Falls as a nesting site. The survey revealed that more than half (51%) of the tourist had not observed any changes in bird population in the area (see Figure 5.10).

Figure 5:10: Perceived impact of climate change on bird life in Victoria Falls (n=364)



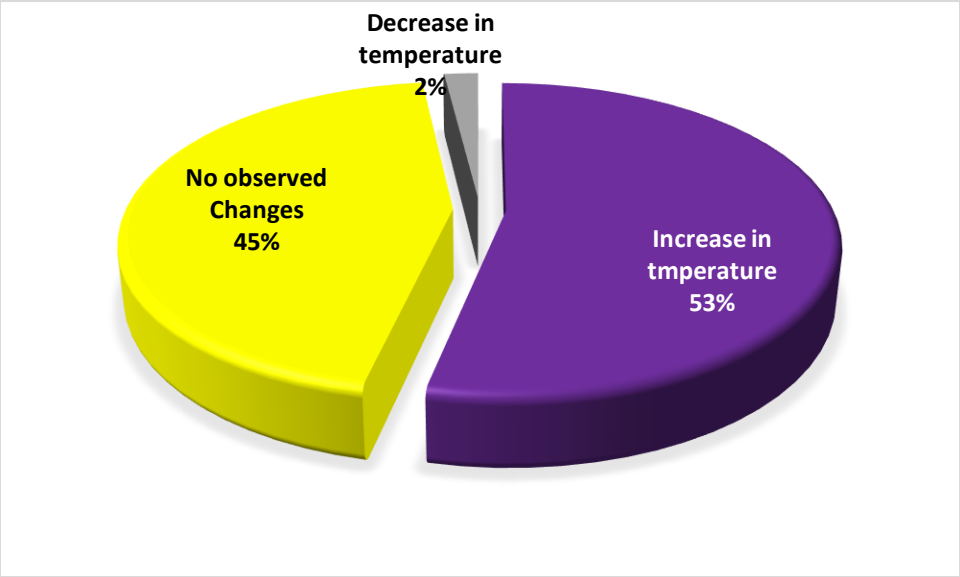
Source: Fieldwork 2017

A significant number of respondents constituting more than a third of respondents reported that they had noticed a decrease in the population of birds with one in ten tourists reporting that some bird species had vanished from the Victoria Falls area. The loss of bird population can be attributed to habitat changes in the area or increased human encroachment into previously wildlife areas caused by urbanisation.

Weather is an important parameter in the tourism industry in which most activities and attractions depend on. Numerous models have been developed to try and assess tourists comfort based on the weather of the destination although none of these models has found use in Africa due to data challenges and geographical inapplicability (Fitchett et al., 2016). Given the perceived changes in climate, tourists were asked to outline changes in weather and climate they had observed over the years. More than half, of tourists, indicated that they had observed an increase in temperature over the years. Slightly less than half of the respondents as shown in Figure 5.11 indicated that they had not observed any changes in temperature over the years. A small part of the population noted a decrease in temperature. The tourist had a chance to comment on their answer. It emerged from these comments that the weather in the resort was scorching and unbearably humid in November and October which they found quite uncomfortable.

Some respondents pointed out that the winters were warm and dry whereas summers were sweltering an indication of the climatic pattern of the resort town. The observation of temperature increase might be valid as Graham et al. (2011), had projected a 2.9°C increase in the Zambezi basin as a consequence of climate change.

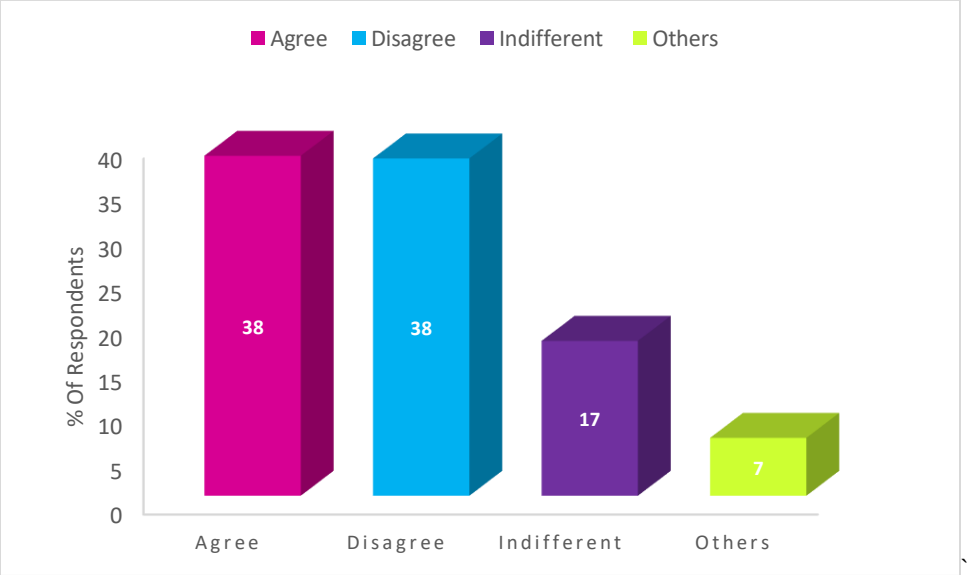
Figure 5:11: Perceived Temperature Patterns at Victoria Falls (n=345)



Source: Field Work (2017)

Climate change will likely affect tourist pattern in the future, which may affect revenue inflow for the tourism industry and the host community. The magnitude at which climate change will alter the destinations will affect its pull factor. Tourists were asked if they will reconsider visiting the Victoria Falls even if it dries up. As shown in Figure 5.12, there was a split between those who will reconsider visiting the Victoria Falls and those who would not reconsider each getting 38%. The Victoria Falls might lose 38% of its market because of climate change if it dries up. On 'other' comments, most of the respondents noted that a "dry waterfalls mean no visits from them". Only a small fraction highlighted that they would visit the area to enjoy the natural and beautiful geology of the Victoria Falls and to reminisce about the former seven world wonder. A small portion was adamant that the Victoria Falls would not dry up and as such, they will continue coming to Victoria Falls to enjoy it.

Figure 5:12: Will tourist visit a dried-up Victoria Falls? (n=370)



Source: Field Work (2017)

5.5 Perceived Impact of extreme droughts and extreme temperatures

The content of Facebook postings revealed that the news of Victoria Falls drying up trended for some days indicated the level of interest and the likely impact of such an occurrence for both companies and tourists. Most businesses operating in Victoria Falls were at pains to explain that it was a natural trend. Although thousands of pictures were circulated on social media showing the extent of water levels at the waterfalls various explanations were given for the phenomenon by different tourism stakeholders.

Google reviews for 300 tourists from 2014 to 2016 were analysed both regarding star rating and content. Resort satisfaction is mostly a factor of climatic conditions that prevail at a destination (Fitchett et al., 2016). Results indicated a general trend for lower star rating during known extreme weather events. Secondary data analysis was also conducted by studying the literature on evidence of climate change.

Content analysis of 5095 reviews from Tripadvisor was conducted. The general complaint that was picked up was that during the dry season in 2015 the falls virtually dried up something never seen before especially on the Zambian side. Most tourists discouraged

visiting the resort during early summer or recommended others to visit the Zimbabwean side which had some water flowing during that time. This concern was more pronounced during the 2015 El Niño extreme drought that affected the whole of Southern Africa.

What is worrying from the emerging trend is that there is a real chance that in the long run reduced water levels may result in the change from the Victoria Falls being a perennial attraction to a seasonal attraction. As the Victoria Falls tide turns into a Victoria gorge, there will be the severe negative impact on some tourist attractions. The severe water flow drop at the resort between September and February is a concern as 26% of the total tourists gave the resort between average and poor review on TripAdvisor. Some experts reported that water levels had hit the 30-year low mark and the remainder saying it was a typical fluctuation cycle of the Victoria Falls. As a consequent water flow on the falls on the Zambian side had virtually dried up as this was at an all-time low.

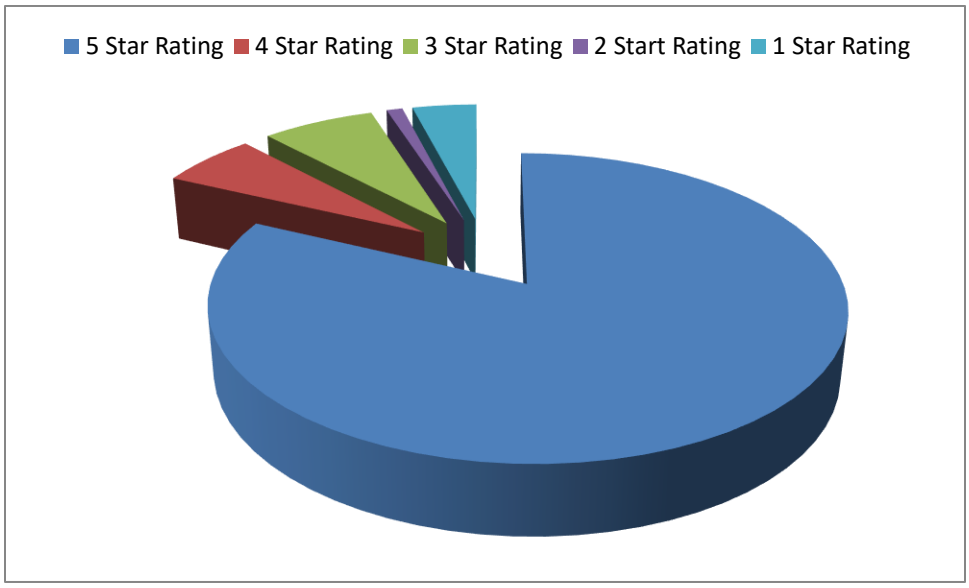
The tourists were anxious about the report of the drying up of the Victoria Falls with the majority taking to Facebook and Twitter to share pictures of the purported dried up Victoria 'gorge'. These pictures received wide attention, circulation and were widely shared, liked and commented on by people who had either visited Victoria Falls or those who intended to visit it shortly. Most comments blamed climate change for the 'disaster' at the waterfalls with Zambians blaming the government and the local power supplier and drought for the water shortage at the waterfalls. To highlight the beauty and possibly potential negative impacts from reduced water flows into the Victoria Falls, an example of a photograph that was taken in the dry month of October 2015 (Figures 5.13).

Figure 5:13: Some unusual levels of dry parts of the main falls (not witnessed before)

Source: Fieldwork 2015

The overall rating for Victoria Falls was 4.6 out of 5 on Google Reviews whereas the overall rating on Tripadvisor is 5. The researcher noted an interesting trend. Out of the 300 reviews that were made the lowest ratings for Victoria Falls were recorded in 2015 with only a single negative review of the 3-star rating given in 2014 (Figure 5.14). The 3-star rater tourist cited that they had received bad service in Victoria Falls and naming one family food outlet as the culprit of poor service. What emerges from the Google Reviews ratings is that the Victoria Falls remains an attractive tourist destination and therefore, the threat from climate change is likely to impact on these perceptions.

Figure 5:14: Victoria Falls Google Reviews Ratings 2014-2016



Source: Fieldwork (2017)

The findings further revealed that even though there is a potential for adverse impacts of climate change on the Victoria Falls, the resort offers all year-round activities that cater for different segments of tourists during different seasons of the year. For example, a significant reduction in water flow attributed directly and indirectly to climate change as consequent of extreme droughts and high temperatures and increased water demand on the upper Zambezi might not necessarily be a bad thing. Some other activities like white water rafting and swimming at the famous Devil's Pool are only feasible when water levels are low. These two adventure activities are popular with tourists. The activities also shut down entirely during the high peak periods in summer which is usually between February and May.

It, however, emerged that most travel agents discourage tourists from visiting the Victoria Falls between October and November as they consider it a period of highly uncomfortable temperatures. They also flag visiting the falls during summer between January and May as they deem it a very uncomfortable period to visit due to a combination of high temperatures and humidity, which can be very upsetting to tourists. Even though the falls are at their peak due to river flooding during this period, travel agents indicated that it is tough to conduct photography at the falls during this time because of the heavy sprays which are like a constant downpour of rain something that was also confirmed by some

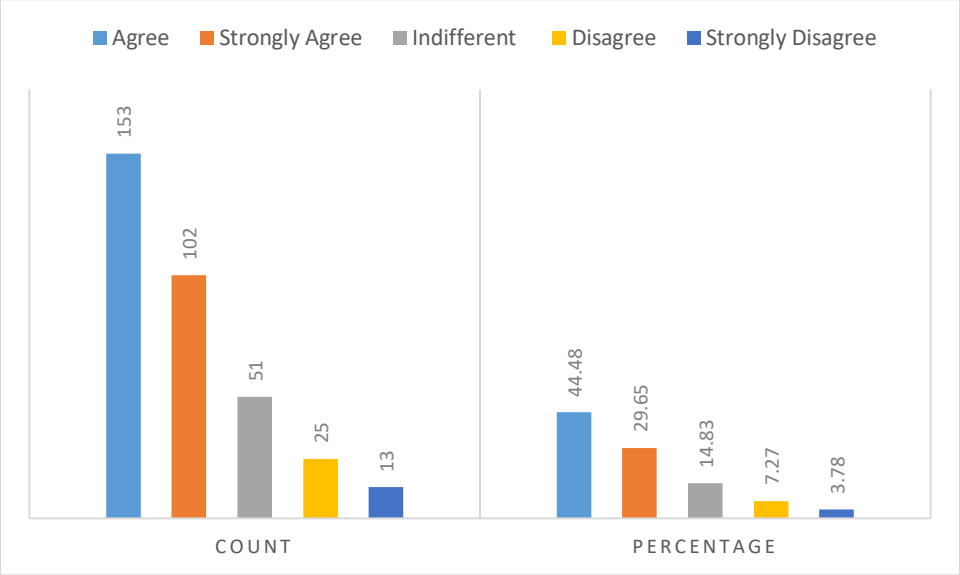
tourists. Most travel advisors agreed that the best period to visit is between June and September as the water levels are low enough to allow for multiple activities. The climate during this time is magnificent and comfortable for tourists. There was strong agreement that during this period a tourist could get the best experience of the sub-region ranging from game viewing to participating in activities at the Victoria Falls. The above pattern is set to be distorted by extreme weather events disturbing the natural rhythm and tourism season in the Victoria Falls.

5.6 Last Chance Tourism Prospects for Victoria Falls

As noted earlier the advent of climate change has created a stampede in certain tourist destinations around the world as tourists rush to experience the resorts before they 'disappear' or transformed by climate change (Lemelin et al., 2010). This phenomenon has created a boom in affected regions and at times to the detriment of the already vulnerable resort. Last chance tourism is expected to shape the tourism trends in certain identified under threat regions and attractions such as Antarctica, Mt Kilimanjaro and the Great Barrier Reef to mention but a few. If there be substantiated, evidence that the Victoria Falls is seriously threatened with drying up the resort town will experience an influx of tourists who would wish to see the falls before they dry up.

About three quarters (75%) people who responded to that question indicated that would visit the Victoria Falls before it dries up. Only a small fraction of the respondents stated that they would not come to Victoria Falls as part of last chance tourism 11% as shown in Figure 5.15. Victoria Falls depending on the scientific findings would have the potential for last chance tourism if it were to dry up. Given the findings, it is not impossible to see tourist restricting themselves to visiting Victoria Falls in certain months and other months recording low arrivals. If the October months continue to heat up and drying up tourist arrivals for it and November can be negatively affected.

Figure 5:15: Last Chance Tourism prospects for Victoria Falls



Source: Field Work 2017

5.7 Other Tourist Concerns

When asked to give closing remarks some tourists took the time to highlight some of the issues raised in the research to emphasise or highlight their feelings. Some tourists indicated that participating in the survey was an eye-opener as it afforded them a chance to seriously think and take stock of their actions at a tourist resort. They highlighted the need for tourists to behave more responsibly and to act as change agents in dealing with climate change. They also raised concerns about transport singling out that aeroplanes produce carbon emissions. At least two tourists indicated that there is a need to put in place fuel tax that is aimed at dealing with climate change. They indicated that if the falls were to dry it would prove dire to the economies of Zimbabwe and Zambia. As such the proponents called for action to ensure that such a thing does not happen. Tourist also feared that climate change might lead to the construction of dams upstream something that will seriously affect the flow at the falls.

5.8 Chapter Conclusion

The chapter was aimed at highlighting the perceptions on, and attitudes of tourists on climate change. The survey reveals that climate change is a worrying concern amongst

tourists that have visited Victoria Falls. Tourists fear that climate change will negatively affect this world heritage site. In as much as tourists visit the Victoria Falls, there are secondary attractions which form part of the Victoria Falls experience that may be directly or indirectly vulnerable to climate change. Tourists believe that the Victoria Falls is highly unlikely to dry up given the larger catchment where the Victoria Falls gets its water. There is, however, a fear that climate change induced extreme events will drastically affect the water flow pattern diminishing the beauty of the falls and the supporting environment. Tourists surveyed indicated that they prefer a full discharge, Victoria Falls, as they find it more enjoyable.

Tourists further reported that although they are concerned about climate change, they felt that government and civil society must play a leading role in dealing with the issue of climate. However, they feel that there is insufficient legal and political will to tackle the challenge of climate change. A significant number of tourists who have been multiple visitors to the Victoria Falls have witnessed some evidence in the area that indicates that climate and the environment are changing in the area. The observed changes include; reduced water flow at the falls, drying up of vegetation, reduced animal and bird population. Although there are other factors that could have led to this tourist feel that climate change is attributed to some of these changes. If the Victoria Falls were to dry it stands to lose about two-fifths of its current market share as the as the Victoria Falls resort is the main attraction. A minority of tourists who would, however, visit the Victoria Falls to enjoy the geological splendour of the area. If the Victoria Falls were to be under any threat of drying up there is any indication that there will be a huge influx of tourists to participate in last chance tourism.

Chapter 6 : Tourism Business Perceptions of Climate change

6.1 Introduction

This chapter discusses findings from key interviews, a door to door and an online survey that was conducted in the Victoria Falls town with the objective of soliciting information on business's perceptions of climate change. The tour operators and other stakeholders in Victoria Falls area are well placed to notice any changes that may have occurred over the past years. Since the tourism industry is the single predominant industry driving the town, the Victoria Falls community's take on the implications of climate change on the resort town is even higher. This chapter, therefore, reports on the findings of the online survey, interviews and self-administered questionnaire conducted in Victoria Falls between November 2016 and May 2017. The chapter is divided into two main subsections; the first section covers the profile and perceptions of the tourism stakeholders with the latter focusing on the perceived evidence and the impact of climate change.

6.2 Profile of Respondents

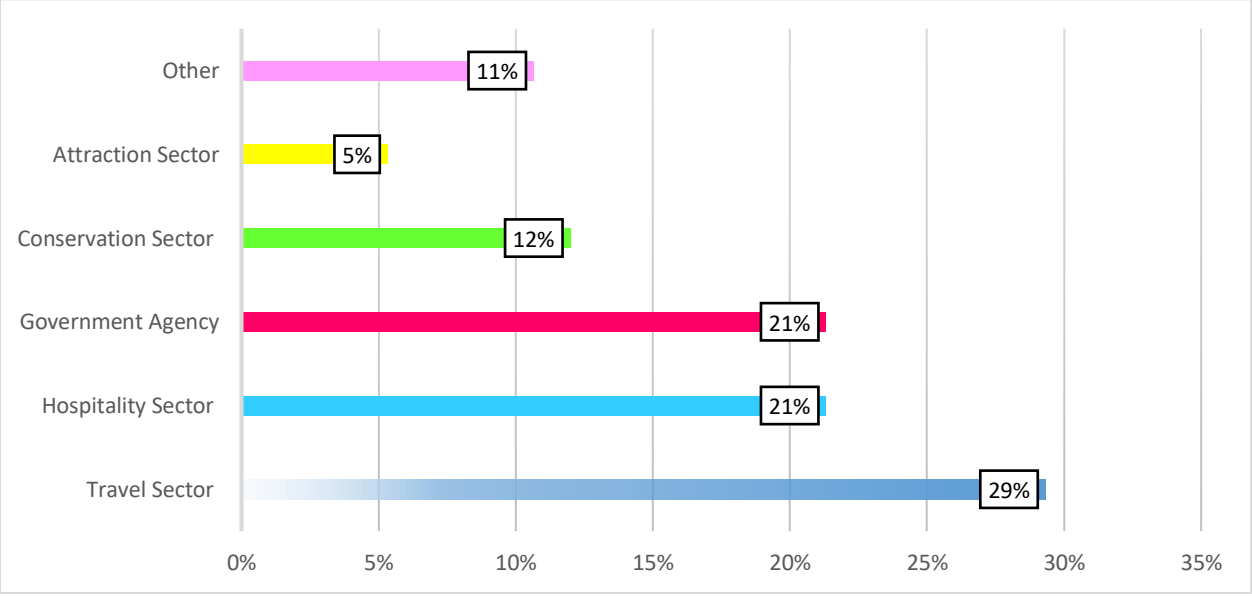
The study reveals that data was collected from people who have stayed in the resort town for varying periods with most of them have stayed in the Victoria Falls for a prolonged period spanning many decades. Up to 70% of the respondents had stayed in the area for five years or more. This means the bulk of the 77 respondents were reasonably knowledgeable about the area's history and capable of reasonably articulating some of the matters raised in the research. A vibrant mix of respondents was ensured to allow for cross-field representation of the entire tourism value chain. The findings, therefore, can be said to be representative of the tourism community in the area.

About a third (30%) of respondents had resided in Victoria Falls for less than a year. A sizeable portion of the respondents (slightly less than one-fifth) of the respondents had stayed in the area for more than two decades or were born and grew up in the area. Such people provided useful insight into the climate and environmental history of the area.

Most respondents were educated individuals, with about 85% of them possessing a tertiary qualification. The level of education is an essential consideration in engaging people about climate change. Education illuminates understanding of complex matters in life, which allows people to grasp and make better-informed decisions. Given the complexity of climate change, a considerable level of tertiary qualification is critical in validating responses and understanding of the occurrences by respondents. As argued by Hamilton (2011), there is a relation between the level of education to climate change consciousness and concern.

Another important consideration in data collection was the issue of sectoral representation. Respondents were grouped in a manner that is representative of the tourism sector to give a voice to each sector and subgroup in the resort town. The configuration of the respondents is shown in Figure 6.1. The category 'other' comprised of individuals working for the UN, local government, researchers, academics, traditional leaders and urban planning and development. The results give a near accurate picture of the resort town. Most people in the town either work in the travel sector, hospitality sector or work for government agencies.

Figure 6:1: Respondents by sector (n=77)

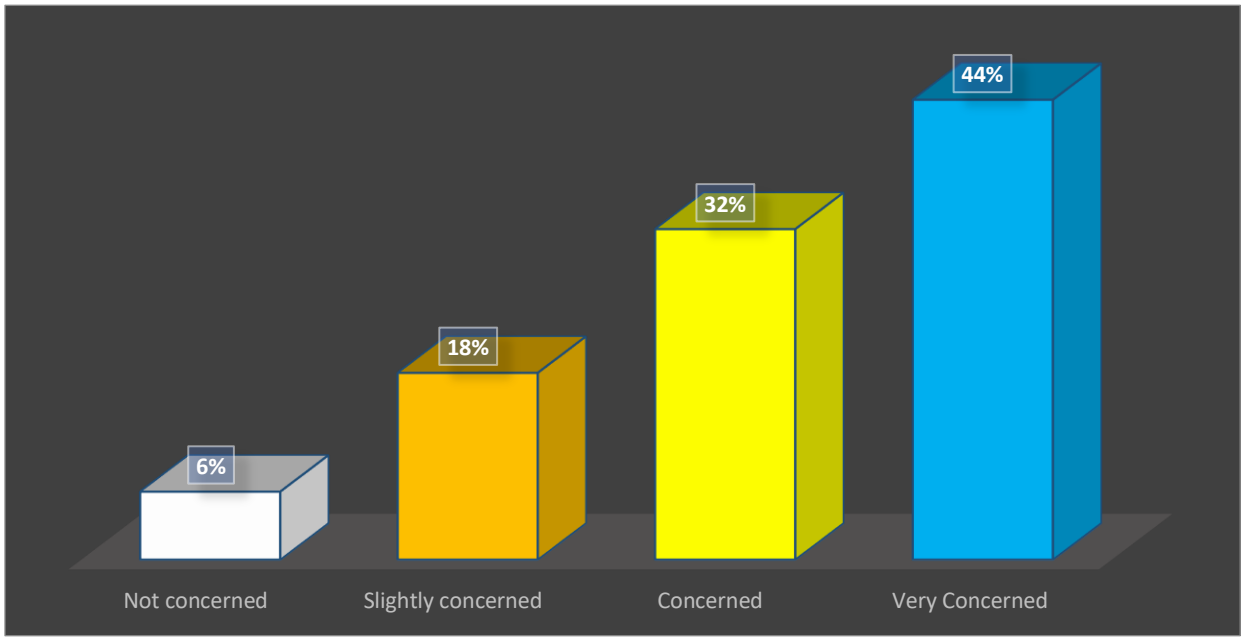


Source: Fieldwork (2017)

6.3 Perceptions and attitudes to Climate Change

Climate change concern is believed to be a factor of experience, beliefs and perceived knowledge and is a central predictor of action (Shi et al., 2016; Prokopy et al., 2016). As such, tourism role players were asked to rank their level of concern with regards to climate change in the resort town. As shown in Figure 6.2, the research found that most respondents were concerned about climate change. It was noted that 94% of the tourism stakeholders were concerned about climate change with a varying level of concern. Only 6% of the population indicated that they were not concerned about climate change impacts. The high levels of concern can be attributed to numerous extreme weather events such as droughts and increased incidence of heatwaves in the area over the past few years as observed by Dube and Nhamo (2018) (Section 4.3). This means that the respondents are awake and conscious of the challenges and unusual weather events attributed to climate change. The business community in the town believes that climate change is a real threat to the town's way of life. As such, there is potential to translate that into climate action.

Figure 6.2: Climate change level of concern (n=77)



Source: Fieldwork (2017)

The level of concern over climate change is much higher in Victoria Falls as it stands at 94% in comparison to levels in other countries such as Ethiopia where the level of concern stands at 80% (Regassa and Stoecker, 2014). There are a number of factors that shape levels of concern which includes media exposure to climate information and experience with an extreme weather event attributed to climate change. Recent extreme droughts believed to have been worsened by climate change could be a precipitating factor for such high levels of concern. Such high levels of concern for climate change may be good as they provide a fertile ground for action and engagement over the issue of climate change and seeking of climate solutions.

To drive climate change action, it is imperative to have the views of the respondents under review regarding their perceptions as to the causes of climate change. As such, the business community was asked to explain what they perceive to be the causes of climate change. It emerged that the majority of stakeholders within the tourism sector in the Victoria Falls area believe that climate change is anthropogenically driven. More than two-thirds (69%) of the surveyed population indicated that they believe that climate change is a consequence of human activities.

The findings show that Victoria Falls tourism partners opinion on the matter are much higher as compared to global statistics. This might be attributed to high levels of consciousness and concern for climate change as reported earlier on. Only 46% of the global population believe climate change is caused by human beings according to Schandl and Walker (2017). Close to one in five (18%) of respondents believed that climate change is a consequent of natural processes. Most of those who indicated others (14%) believed that climate change is caused by a combination of human and natural processes. The understanding that climate change is caused by human activities is critical in ascertaining accountability and addressing climate change and in drafting adaptation and mitigation strategies.

Given the wide circulation and panic amongst tourists and ordinary citizens in 2014/2015 over the perceived drying of the Victoria Falls waterfalls, stakeholders were asked to give their opinion on the matter and prospects of the Victoria Falls drying up in the foreseeable

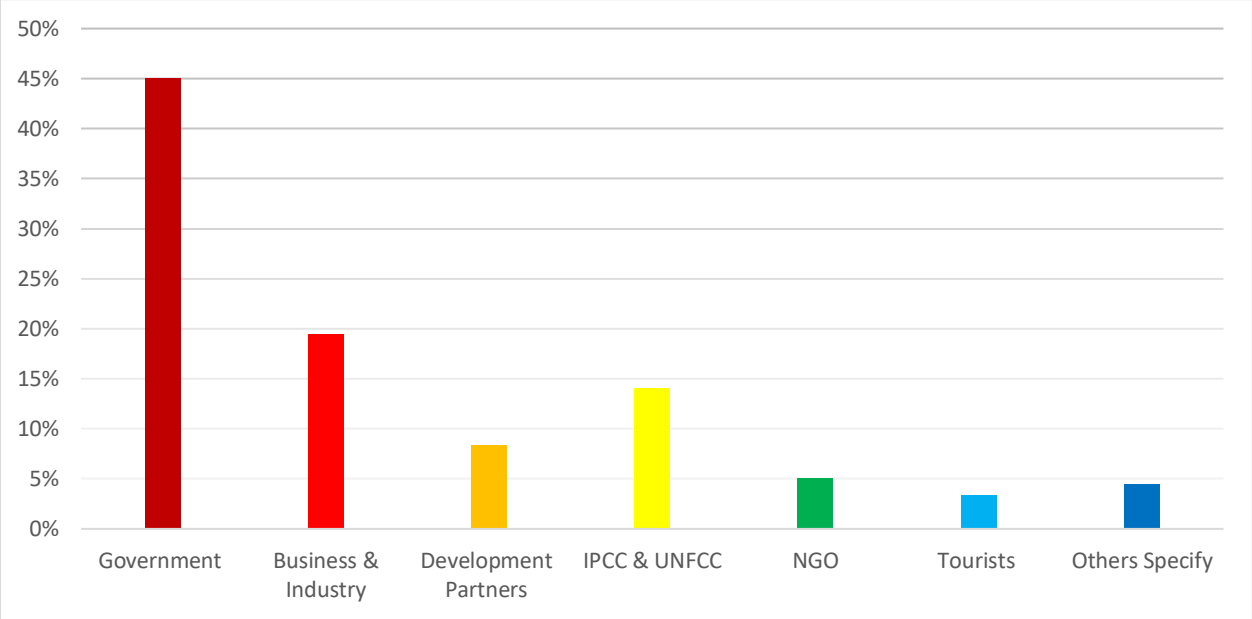
future. Slightly more than half (54%) of the respondents opinionated that the Victoria Falls will not dry up. However, about one in four (26%) indicated that they believed the waterfalls were drying up. This could be because of the 2015 drought episode which led to a significant drop in water flow at the waterfalls. The water flow decline could result in the waterfalls drying up in that month if the trend continues in the near future or during extreme drought period according to findings in Section 4.5. One in four respondents indicated that they were not sure as it was very difficult to say with accuracy in the absence of scientific data as they have seen a growing trend of unusual water flow at the waterfalls. Some years were reported to be punctuated by extremely high-water flows citing 2008 as an example. The year 2014 and 2015 was cited as a year that recorded extremely extremely low water flows. They also indicated that this water flow pattern could be cyclic, further calling for the need for scientific research to answer this question.

It can be argued that the 54% figure of those that believe that the Victoria Falls is not drying up is still a low figure regarding confidence and the perceived level of threat to the Victoria Falls. The fact that only slightly more than half of the tourism community believe that the Victoria Falls is safe from drying up is a concern and exposes the level of threat the World Heritage Site is exposed to. As such one can argue that the perception and level of threat from climate change are significant as seen from other World Heritage Site of similar stature such as the Great Barrier Reef in Australia as noted by Wolff et al. (2018).

Tourism industry players were further asked to identify the top three organs they felt are central in dealing with the problem of climate change. Close to half of the population (45%) as shown in Figure 6.3 expected government to play a leading role in addressing climate change. While recognising that climate change management requires combined effort, there is an anticipation that both local and national government play a central role in the climate change space as they provide the policy and legal framework to deal with climate change. In many settings, governments are responsible for downscaling climate change information and play a central role in capacity building and building resilience and adaption for climate change (Nalau et al., 2017). Governments can assist with allocating funds for climate change management through budget allocation, research funding and

identifying areas of vulnerability. This gives credence to the fact that dealing with climate change requires strong governance at national and local levels. Nonetheless, business needs to have a more appreciation of their role in climate action if the fight against climate change is to be won. Business is the ultimate implementer of policies and can fund research and innovation in the quest against climate action.

Figure 6:3: Top three organs chosen to deal with the problem of climate change (n=77).



Source: Fieldwork 2017

On the other hand, it emerged that close to a quarter of the respondents chose those in business and industry to be the second option in dealing with climate change. Business and industry have an important role to play in dealing with and addressing climate change as part of the multi-stakeholder group that plays a central role in the implementation of mechanisms and mitigation strategies. The rules and ethos of globalisation that demand closer interaction between state actors and the private sector in the climate change debate and intervention remain valid. There is a need for private sector to embrace ethical business practices, which is not detrimental to the environment and many accounting

standards require the inclusion of sustainability plans that respond to social and environmental issues (Kourula et al., 2017).

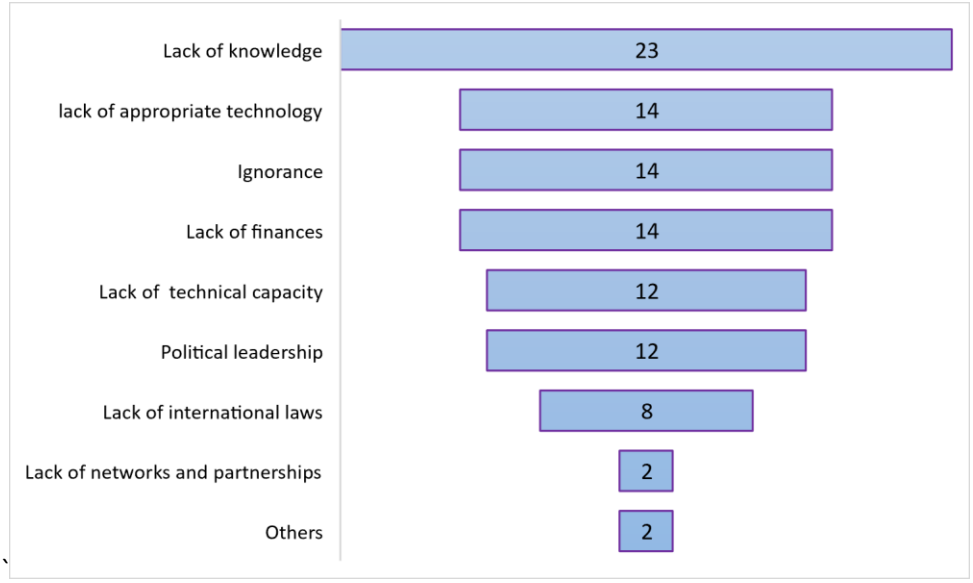
As most of the respondents are business owners and managers, the understanding that as a business they have a crucial role to play in tackling climate change is critical in ensuring that mitigation and adaptation strategies are put in place. This could explain why some businesses in the resort town have embraced green tourism initiatives. The number of such, is, however, still low given the urgency that is needed to address climate change by the tourism sector. Curtailing climate change will require every business entity in the resort town to be onboard for significant contribution to be made in both mitigating and adaption.

However, most of the tourism stakeholders do not see any role that can be played by tourists in dealing with the challenge of climate change. A small portion (4%) of the respondents felt that tourists have a role in addressing the problem of climate change. This might be because of lack of knowledge or ignorance to the significant role that tourists can play in this regard such as altering behaviour and purchasing patterns to adapt or mitigate climate change. This is contrary to global calls that tourists should be major stakeholders in addressing climate change (Hindley and Font, 2017). As major stakeholder, tourists need to be included in both carbon reduction and adaptation measures for climate change. The low understanding of the role of the tourist in dealing with climate change issues is demonstrated by the absence of initiatives targeted at tourists to participate in carbon reduction initiatives in almost all establishments in Victoria Falls. The door to door survey reveals that only a handful of accommodation buildings were retrofitted with energy and water saving gadgets or guidelines for tourists on responsible tourism practice.

Quizzed on what three significant challenges were encountered in addressing the climate change issue, the tourism industry identified lack of knowledge, followed by the lack of appropriate technology and a tie for the third challenge identified as ignorance and lack of finances (Figure 6.4). Lack of networks and partnerships was also identified as the least problems in addressing climate change. The findings are not unique to the Victoria

Falls community as studies elsewhere had found that knowledge gaps were a stumbling block in dealing with climate change (IPCC, 2015; Liu et al., 2016). There is, therefore, a greater need to close this knowledge gap through intensifying research and knowledge sharing efforts through environmental education and other such measures to tackle the menace of climate change.

Figure 6:4: Challenges faced by tourism role players in dealing with climate change (n=75)



Source: Field Work (2017)

Technological innovation and transfer have a central role in dealing with the climate change problem. To deal with climate change effectively, countries have to invest and conduct research and embrace local relevant technology that abates and reduces carbon emissions and assist in the adaptation efforts by various countries. As a developing country with competing demands, it would appear that Zimbabwe and the business sector are struggling to innovate their business to ecologically friendly technology that assists in either reducing their carbon footprint or adapting to the vagaries of climate change. Jiang et al., (2017) and Nishijima (2017), argue that dealing with climate change requires technological innovation that is tailored and designed around the notion of ecological civilisation and energy efficiency in a manner that reduces the carbon footprint.

Given the growing concern over the tourism carbon footprint and the need for transparency in the sector post the 2015 Conference of Parties-COP21 Paris Agreement on climate change, there is a need for increased training in the area of climate change for the tourism industry in Victoria Falls. This should be done to capacitate business with necessary knowledge and skills in green tourism development. Training is also needed in conducting carbon audits which will enable the business to monitor their progress in greenhouse gas emission reduction.

On the other hand, Robichaud (2016), argues that ignorance has been used by certain individuals to escape culpability and responsibility. As such the notion of ignorance by tourism stakeholders need to be treated with scepticism. In many settings, the tourism industry has often been blamed for failing to be transparent and of lacking accountability with regards to climate change issues (Scott et al., 2016b). While in the IPCC's Fifth Assessment Report (AR5) the tourism positions have been strengthened with knowledge gaps being reported in other regions of the world according to Scott et al. (2016a), there is a need to intensify climate change education in Africa. This may particularly speed up mitigation and adaptation efforts in the tourism sector.

6.4 Perceived implications of climate change on the Victoria Falls

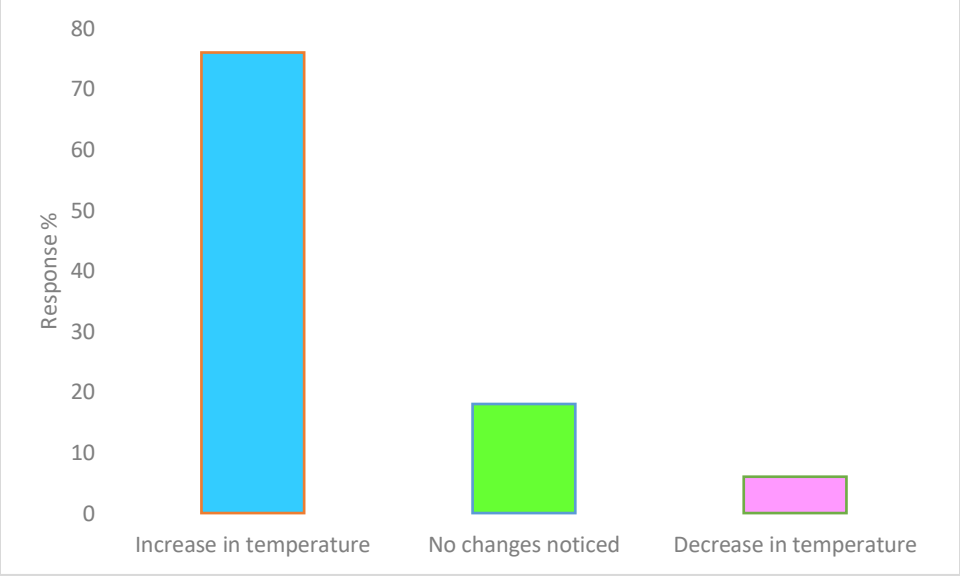
This subsection presents how the Victoria Falls community perceives climate change to have affected the tourism product in the resort town. A summary of the main observations is presented as noted by community members over the years that can be attributed to climate change and climate variability. The Victoria Falls community pays particular attention to the environment as it is directly or indirectly a significant source of livelihood for the resort town. Changes in the biophysical environment affect life in the resort town in various ways. In the following paragraphs, discussions are presented regarding climate change impacts on temperature and rainfall, the Zambezi River flows regimes and wildlife.

6.4.1 Impact of climate change on temperature and rainfall

Temperature is a crucial weather element in Victoria Falls as it has a direct and indirect bearing on activities and tourism operations. Most respondents (76%) opinionated that the Victoria Falls area had experienced some increase in temperature over the years

(Figure 6.5). Most of these respondents indicated that October was unusual hot confirming the findings in Section 4.3 (Dube and Nhamo 2018a&b) who observed a temperature increase of about 1°C in the last four decades. The research found that due to increasing temperatures, activities such as elephant rides were now restricted to early mornings and evening hours, to limit dehydration of visitors during the hot afternoons. There is, therefore, an expected reduction in revenue from this activity due to shortened periods. However, respondents noted that during the day tourists tend to participate in water activities such as white-water rafting, fishing and swimming, which have a cooling effect on the human body. Notably, water activities are encouraged in the afternoon and early evening hours. The study also found that depending on the season, walking trails in the rainforest can be undertaken and adventure swimming in the Devil's Pool at the top edge of the Victoria Falls.

Figure 6:5: Perceptions of temperature changes (n=67)



Source: Field Work (2017)

Some businesses indicated that because of increased temperatures, they were now being forced to buy expensive air conditioners and fans thereby increasing the running costs as temperatures escalate during summer months. This was common for hospitality establishments to ensure guests comfort especially during the hot, humid summer months. The hoteliers and other hospitality players indicated that the demand for air-

conditioning was costly as it increased capital expenditure and operating costs at a time they were seeking to cut costs. Regardless of the challenges of electricity supply in Zimbabwe, the growing demand for electricity due to increased temperatures from climate change remains an opportunity to green power producers and the consequent employment in a country that is energy and job-starved. There might be a need to re-engineer buildings to make them heatproof and reduce cooling needs.

The study also revealed that the demand for water during the peak dry and the hot season had gone up in recent years. This was attributed to increased evaporation rates from increased temperatures for both animal and human-related activities. This resulted in increased water bills for companies and increased infrastructure development demands. Furthermore, it was reported that an increase in the demand for beverages and water was characteristic of hot days. The potential winners from this phenomenon were noted as local and international suppliers and vendors of bottled water and other cold beverages due to increased demand associated with such weather conditions.

The summer temperatures were reported to be much warmer than before, and this adversely affected most business in the area. The attraction sector indicated that an increase in temperature was problematic for animals in a number of ways. Firstly, tour operators and national park officials reported that due to high temperatures animals were staying in the shade for longer hours making it difficult for tourists to see them when taken for game drives. This had the potential of affecting tourists' satisfaction levels during the hot summer months. National park officials and private game owners further indicated that an increase in temperature meant an increase in animal water demand and fast drying of animal watering points. This was increasing their operating costs as they had to put extra measures to provide water for animals.

Park officials and tour guides noted that the high temperatures made it difficult to work outdoors due to the intense heat. They reported that even morning hours were now becoming increasingly hot, humid, and uncomfortable. Tour operators indicated that some tourists were not so keen to participate in activities when it was scorching hot and

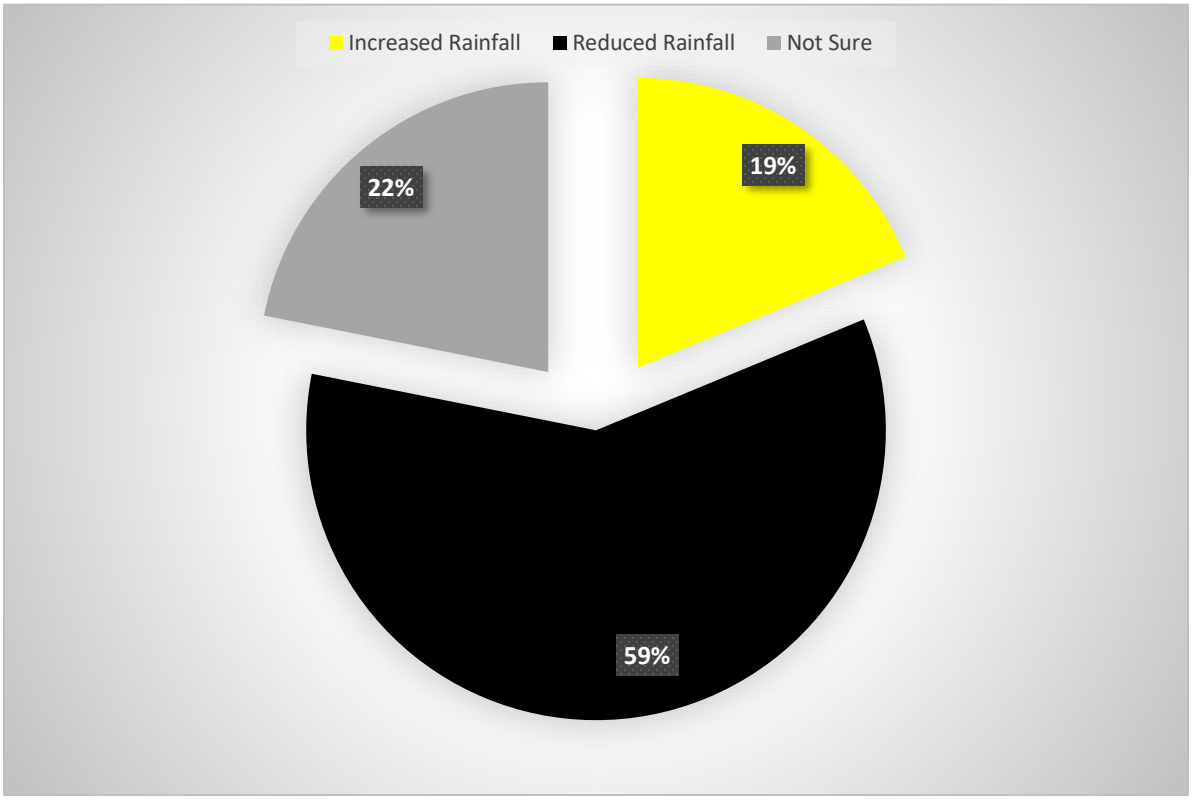
would cancel activities to stay in cool palisades. A few respondents had experienced sunburn, and the fear was that this might affect tourists' repeat visit plans.

Two out of the prominent three helicopter companies complained that the ever-increasing temperatures in the area were disruptive to their operations of providing helicopter views of the Mosi-oa-Tunya (Victoria Falls) to the tourists. Helicopter engineers and helicopter pilots indicated that they experience difficulties in the operational efficiency of the helicopter when temperatures rise above 35°C which was becoming a trend in summer recently.

Tourism role players were also asked to give their opinion on rainfall trends in the area over the years. It merged that more than half (59%) of the tourism players operating in the Victoria Falls indicated that they had noticed a general decrease in rainfall amount in the area over the years as shown in Figure 6.6.

Some of the uncertainty regarding rainfall patterns could be a consequence of extremes of drought and heavy precipitation in the area which makes it difficult to articulate what could be happening. The tourism players noted that this had varying impacts on tourism activities and products in the area. Respondents noted that a decline in rainfall over the years had resulted in a reduction in available food for animals and human beings in the area. Reduced food availability for animals was partly to blame for the reduced animal population in other areas. Reduced rainfall also triggered food inflation, and operators reported that food shortages often lead to increases in food prices for hotels and this had a knock-on effect on the tourism value chain. The findings resonate with earlier studies, which found that climate change often led to food inflation (Cammaran and Tian, 2018).

Figure 6:6: Perceptions of impact on rainfall pattern



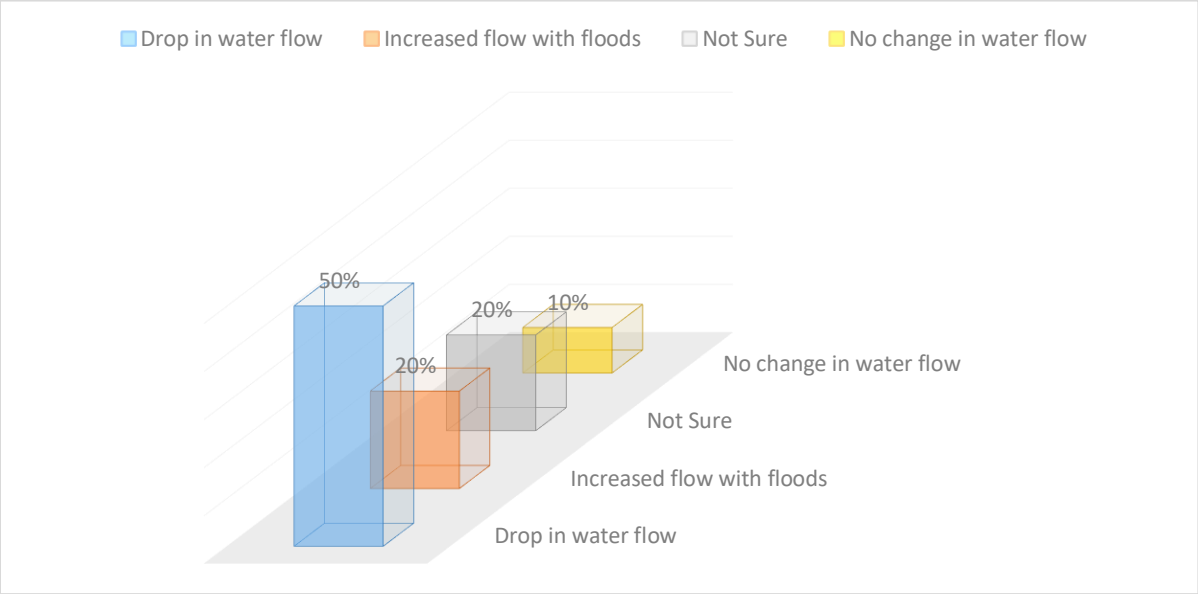
Source: Fieldwork 2017

Other findings were that reduced rainfall activity and amounts had positive effects. For example, reduced water flow at the waterfalls prolonged the seasons' specific activities such as white-water rafting and swimming at the devil's cataract, which was popular with tourist. On the other hand, the observed increase in rainfall activity in 2017 shortened the white-water rafting activities at the falls. Increased rainfall activity also adversely affect game drives as roads in the national parks become impassible. They pointed out that severe rainfall that has become characteristic of the rainy seasons in some` years tended to damage roads making it difficult to access some of the areas by road. Other activities that were cited to be averse to intense rainfall activities included helicopter flights over the falls. On a broad spectrum, there was a consensus that good rains mean good 'thunder' water flow at the falls, which naturally attract more tourist visit to the area.

6.4.2 River flow regime

Half of the respondents indicated that they had witnessed a recession in the Zambezi river flow pattern regime of the river. Successive droughts in the Zambezi Basin, especially in 2014/15 and partly in 2016 led to some tourists arguing that the Victoria Falls waterfalls are drying up. One in five (20%) of the respondents noted that they had witnessed an increase in water flow something that can be attributed to extreme rainfall events witnessed in the area during recent years. There has been observed significant rainfall variations of water flow along the Zambezi River over the years (Section 4.5 and also Dube & Nhamo, 2018a&b). One in ten respondents said they had not witnessed any changes in the river's flow pattern. The total breakdown of how people responded to this question is displayed in Figure 6.7.

Figure 6:7: Observed changes in water flow patterns at Victoria Falls (n=77)



Source: Fieldwork (2017)

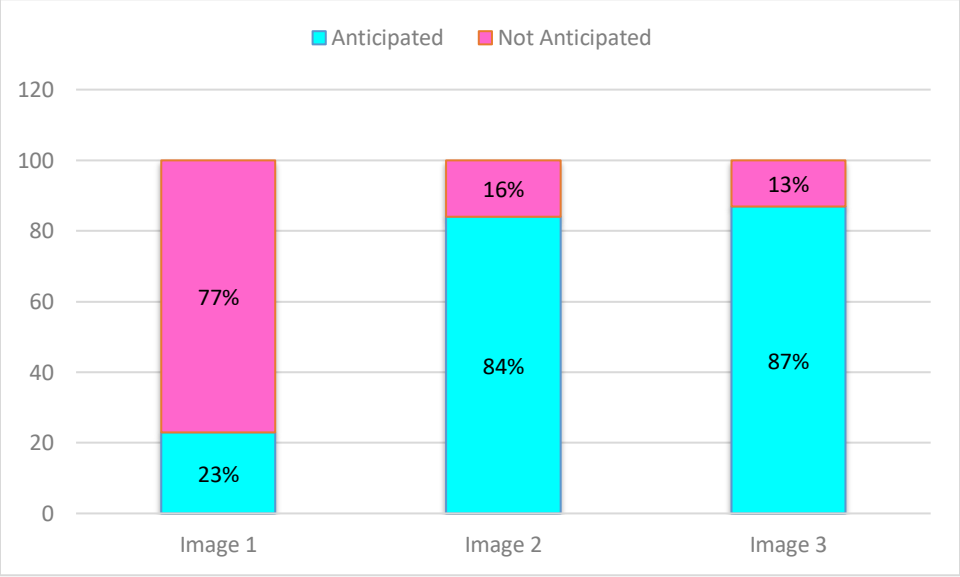
From the field work, it emerged that the Victoria Falls tourism business community is aware of climate change and is genuinely concerned about the implications of climate change on the resort town.

The tourism role players were also asked to rate the three pictures of the waterfalls from three phases of the waterfall namely: peak discharge (image 3), mid-peak discharge

(image 2) and off-peak discharge (image 1) (Figure 6.8a). The results indicated that the tourism role players preferred to see the waterfalls at their peak discharge which is synonymous with full water flow as shown in Figure 8b. The tourism stakeholders indicated that they would prefer to see the Victoria Falls at its peak discharge with much water flowing ("the thunder that flows"). The role players in the tourism sector love to see the waterfall in full discharge, and most establishments had a waterfall fountain at their premises.

Figure 6:8a: Stakeholder perceptions on the scene they like to see most of Victoria Falls

Figure 6.8b: The anticipated and least anticipated picture of Victoria Falls (n=77)



Source: Field Work (2017)

As shown in Figure 6.8b the majority of the tourism role players enjoy seeing the Victoria Falls at its peak and mid-peak discharge. That period offers a beautiful spectacle of the waterfalls and its associated rainbow. The spray of the water during that period will be at

its highest with sprays reaching most parts of the Victoria Falls rainforest. In a testament to this, many establishments have lookout points where tourists can view the water spray from a distant and also take pictures.

During interviews with tourism stakeholders in the Victoria Falls town, they confirmed the results by noting that peak water discharge was the most desired state of the waterfalls as tourists can enjoy walking in the rainforest to enjoy the thunder. The local name Mosi Oa Tunya means the smoke that thunders which further confirms the connection of the peak discharge and the local people.

A small portion of respondents indicated that they enjoy seeing the waterfalls during the dry season. The argument was that during that period it was easy for tourists to swim, take pictures and enjoy the famous white water rafting along the Zambezi rapids. The stakeholders also noted that during the low season, animals concentrated on the river banks making cruises more attractive and appealing activity for tourists. Low season was also the period for water rafting companies to make more money.

6.4.3 Wildlife and climate change in Victoria Falls

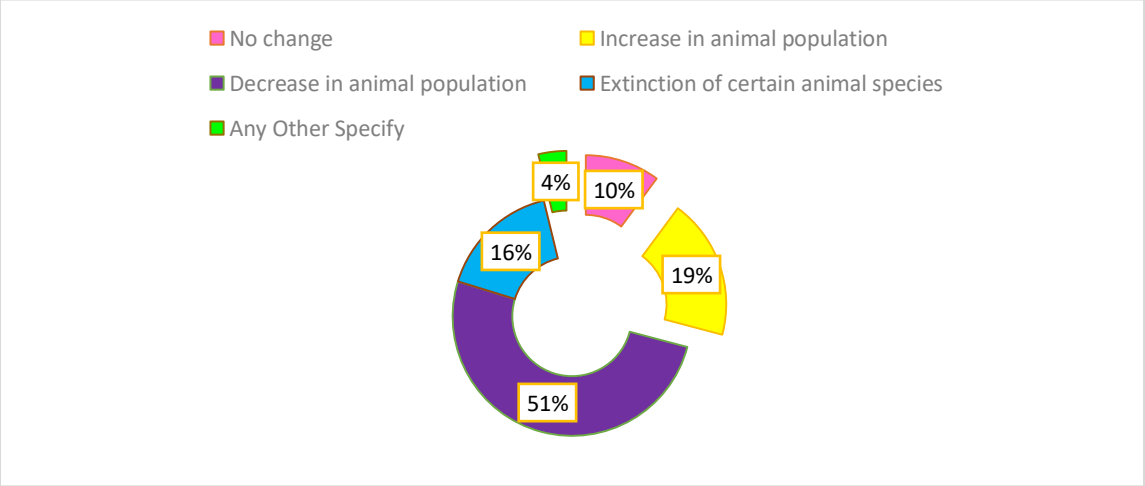
Climate change has been known to affect flora and fauna, which attracts tourists in various parts of the world. Emerging research shows that wildlife is vulnerable to the vagaries of climate change (IPCC, 2014). It emerged from the research that wildlife is a major pull factor for tourist visiting the Victoria Falls. As such tourism organisations and their supporting structures were given an opportunity to make comments on their observations on wildlife in national parks surrounding the Victoria Falls. Slightly more than half of the respondents (51%) noted that over the years they had witnessed an unusual drying of grass and tree species and extinction of individual birds and animals species in general. If their perception is true this might be a testament to the predicted decline of global net primary productivity of $10gCm^{-2}$ $year^{-1}$ as a consequence of climate change (Boone et al., 2017).

About one in ten people said that they had not observed any changes in the area. There was also an indication of biodiversity loss in flora and fauna, extinction of animals, increased human-wildlife conflict and damage to roads due to climate extreme events.

Guerbois and Fritz (2017), had observed increased human-wildlife conflict during years of extreme weather events in areas surrounding Hwange National Park. Overall, there was broad agreement that the animal population in the area had decreased significantly with more than two-thirds of respondents indicating that there was either decrease in animal population and another fraction noting that certain animal species had disappeared.

One in ten of the respondents from the research population pointed out that there were no changes observed in the animal population and 19% reported that animal population had increased in the area over the years. A reduction in net primary productivity reported earlier on would be most likely be responsible for a decline in animal population. It could also be a consequence of increased human conflict as the town encroaches places usually occupied by animals as a consequent of urbanisation. Equally so it could be attributed to increased movement of animals in search of scarce food as a result of drought in the area over the last few years. Figure 6.9 highlights the summary of findings to this question. The observations of the reduced animal population and animal extinction in the national parks around Victoria Falls confirms fears by IPCC (2014), which noted downward changes in animal population as a consequence of climate change in some areas.

Figure 6:9: Impact of climate change on wild animal population



Source: Fieldwork (2017)

Respondents were further asked to give their perceptions of how climate change has affected the birdlife in national parks surrounding the waterfall. It emerged that 45% of the tour operators (n = 77) indicated they had noticed a decrease in birds population in the area as a consequence of climate change. Out of the 45%, nearly 20% said that certain bird species had gone extinct. As such a bird feeding programme had been initiated to save some the species. About 38% of the respondents indicated that they had not observed any changes. Studies carried out in Europe and the USA reported a decline in bird population as a consequence of climate change (Stephens et al., 2016). The Victoria Falls has “riverine ecosystem, breeding ground, habitat or landing base for migratory, endangered bird species making it an Important Bird Area (IBA)” (UNESCO, 2017). There is, therefore, a danger that disturbance of migratory bird pattern or habitat conditions will have a long-lasting impact on birding in the area.

6.5 Conclusion

The study was aimed at examining perceptions, knowledge and attitude on climate change and perceived the impact of climate change in Victoria Falls Zimbabwe. It emerged that while there is a growing sense of awareness of the causes and impacts of climate change on tourism, there are some serious concerns with regards to knowledge gaps in this regard. The knowledge gaps amongst tourism business on climate change have a potential adverse impact on tackling climate change. In addition to that, there are other challenges and obstacles that need to be addressed to effectively deal with climate change. Businesses cited lack of knowledge, technical capacity, ignorance, and poor political leadership as key challenges they are facing in tackling climate change and look to government and IPCC and its stakeholders to assist in addressing these issues and take a leading role in addressing climate change. The tourism business is concerned about climate change, and its impact on Victoria Falls with the majority complaining that the water flow at the waterfalls had declined because of extreme climate events. In addition to that animal and birds’ population in the area had decreased over the years as a consequence of climate change. Extreme weather events in the area destroyed tourism infrastructure, disrupted tourism activities in the area with the potential to upset the tourism activity calendar for the resort town.

Chapter 7 : Mapping Sources of GHG Emissions and Potential Mitigation Interventions

7.1 Introduction

This chapter presents findings on the mapping exercise on key sources and drivers of greenhouse gas (GHG) emissions and the potential mitigation interventions in Victoria Falls. The findings are based on an online survey, secondary data analysis, ground observations and interviews with top management of tour operators and employees. Respondents included personnel from the hospitality and travel sectors, attraction sector and support services. From the literature, it emerged that the tourism industry contributes about 5% of the global GHG and this share is expected to grow by 152% by 2035 (Sharp et al., 2016). Some key sources of GHG emissions identified include the following: aviation, hospitality, tour operators and the attraction sector.

It emerged from the online survey of 370 respondents that tourists stay in the Victoria Falls for a period of between one week and more than a month. Most tourists (91%) spent between one and seven days with a small percentage (4%) spending an average of between one and two weeks. Close to one percent of tourists stay for between three and four weeks, with 4% staying for more than four weeks at a time. The results of the survey show a strong resemblance to those from the Zimbabwe exit survey report of 2016 that revealed that most tourists spend on average, seven nights in Zimbabwe. Although percentages might seem small at face value, the fact that Victoria Falls accounts for about 28% of all tourist arrivals to Zimbabwe makes this significant (Zimbabwe National Statistics Agency-ZIMSTAT, 2016). Tourist stay has a direct bearing on carbon footprint as the longer the tourist stays, the higher their carbon footprint.

This chapter comes in three sections excluding the introductory and concluding sections. These include the aviation sector carbon emissions (Section 7.2), emissions from the hospitality sector (Section 7.3), and lastly, a section that deals with emissions from the tour operators and the attraction sector all combined (Section 7.4).

7.2 Aviation Sector Carbon Emissions

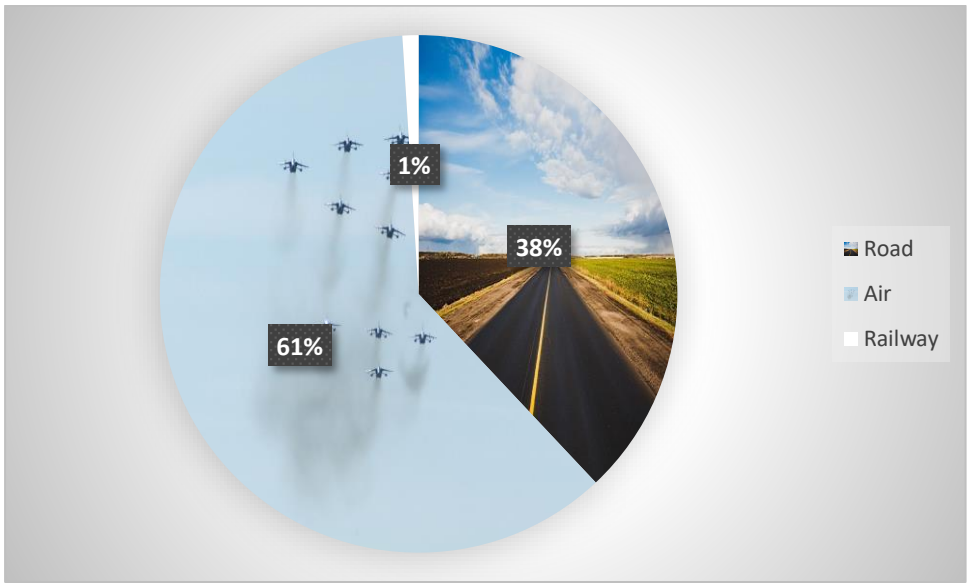
Victoria Falls is a relatively busy tourist destination with several flights from the region and the continent plying the routes as shown in Figure 7.1. Victoria Falls receives more than half a million tourists annually (Dube & Nhamo, 2018b). Most of these flights originate from two South African flight hubs, namely Oliver Reginald (OR) Tambo International Airport in Ekurhuleni, and Cape Town International Airport. The furthest direct flights to Victoria Falls are from Nairobi (Kenya) and Addis Ababa (Ethiopia). Other flights are those from Botswana, Zambia and Namibia. In 2017 three routes were opened to Victoria Falls International Airport and these included the Victoria Falls-Nairobi and Victoria Falls-Addis Ababa route with one flight each. Two new flights joined the Cape Town-Victoria Falls route, and one airline joined the Harare-Victoria Falls route.

Figure 7:1: Victoria Falls aviation servicing routes (routes not to scale)

Source: Field Work (2018)

Figure 7.2 shows that most tourists access the Victoria Falls by air, with a significant number using road transport. The major use of airlines, representing a carbon-intensive industry, means that the carbon footprint for the resort is equally significant. The impact of aviation is likely to be significant given the eco-sensitive nature of the region. However, aviation remains the most viable mode of transport for the 370 respondents who represent over 45 different countries across the globe, while the aviation industry is blamed for contributing about between 2 and 3 per cent of carbon emissions into the atmosphere (Becken and Mackey, 2017).

Figure 7:2: Mode of transport used by tourists to visit Victoria Falls (n=370)



Source: Fieldwork (2017)

Respondents also reported wide use of private transport in their repeated visits to the Victoria Falls. Just less than two-thirds (66%) of the tourists travelled to the resort using private transport. Whether tourists use public or private transport has a direct bearing on the level of the carbon footprint for their tour. What makes the extensive use of private transport worrying is that it comes at a time transport sharing is encouraged to reduce GHG (see Chen and Kockelman, 2016).

The development and upgrading of the Victoria Falls International Airport (VFA) have facilitated the growth of the tourism industry and consequently growth in GHG emissions. This emanates from the growth of both human and vehicular (air and road) traffic into and out of the resort town. The commissioning of the upgraded VFA to accommodate larger aircraft and more airlines has seen an influx of new airline

operators. As of July 2017, four airlines had commissioned flights to the VFA, almost doubling the air traffic at the airport. Out of the three airlines, two offer the long-haul flights from Nairobi and Addis Ababa. Several other charter flights fly to the VFA daily. The next two subsections present estimated carbon emissions from public civil aviation and the resultant mitigation (intervention) measure from the industry.

7.2.1 Estimated carbon emissions

What also emerged from the fieldwork in the study was that the Victoria Falls resort town is near two other international airports located within a 100 km radius. These are the Kasane International Airport (Botswana) and the Livingstone International Airport (Zambia). To this end, the Victoria Falls resort is fast becoming a regional tourism hub for southern Africa outside of Cape Town. Table 7.1 outlines carbon emissions estimates for flights to the Victoria Falls region.

Table 7.1: Average carbon emission estimates for selected major tourist destinations using ICAO calculator

Departure Airport	Type of Aircraft	Distance in km	Aircraft Fuel Burn/leg (KG)	Passenger CO2/Pax/journey(KG) Economy	Passenger CO2/Pax/journey (KG) Premium
Addis Ababa	Boeing 737-700	6 650	11 660.2	563.6	1 127.4
Johannesburg	Boeing 737-400; Airbus A320 (320); Airbus A330-200 (332);	1 854.0	14 298.5	220.6	220.6
Cape Town	Embraer EMB 190, Embraer EJ135	3 808	8 915	636.0	636.0
Harare	320, 737, ER4	1 108	6 318.6	88.0	8 202.8
Bulawayo	320, 737	724.0	5 333.0	114.8	114.8
Nairobi	Embraer EMB 190 / EMB 195 (E90)	4 442.0	13 695.2	571	571.0
Windhoek	ER3 (Embraer ERJ 135)	1 996	4 602.6	469.2	508.6
Livingstone International Airport					
Johannesburg	Boeing 737-800 (738); Boeing 737-400); Airbus A320	1 912	9 959.8	275.4	275.4
Cape Town	Embraer E90	3 862	12 378.6	476.2	476.2
Nelspruit	Embraer ERJ 145 (ER4)	1 998	5 072.4	446.8	446.8
Nairobi	Embraer EMB 190 / EMB 195 (E90)	4 394	13 586.8	522.8	522.8
Lusaka	BAe Jetstream 41 (J41)	788	1 129.0	124.6	124.6

Kasane International Airport					
Johannesburg	Avro RJ85 Avroliner (AR8)	1 954	8 662.4	316.0	316.0
Maun	ATR 72 (AT7)	598	1 327.0	67.2	67.2
Gaborone	Embraer ERJ 145 (ER4)	1504	2 056.2	142.8	142.8

Source: Fieldwork (2017)

The study established that most national and regional flights that ply the Victoria Falls route are old and less fuel efficient. This imposes a hefty carbon footprint for each passenger using air transport to and from the resort. However, aircrafts used by the Kenyan and Ethiopian Airways are modern and fuel efficient, resulting in lower carbon footprints per passenger. The research thus highlighted the fact that local and regional flights to Victoria Falls had a much more significant carbon footprint on distance ratio as compared to international routes on emissions distance factor. However, the Johannesburg route has the most extensive carbon footprint due to (i) the number of flights and frequency on that route and, (ii) fleet age, with the oldest flight being 27 years old. Long- haul flights from Nairobi and Addis Ababa seem to have a lower carbon distance ratio factor as the fleet is very young with its age at an average of 4.5 years.

A carbon emissions calculation that was conducted to ascertain the carbon footprint of the airlines shows that of all the three airports that surround the Victoria Falls indicated that the VFA has the most extensive carbon footprint, as shown in Table 7.2. This is attributed to the high traffic volume as it is the busiest airport of the three.

Table 7.2: Approximated carbon emission for airlines flying into Victoria Falls

			Victoria Falls International Airport (VFA)	
Departing Airport	**Name of Flight**	**Flights/Week**	**Estimated Fuel Burn kg/ Week**	**CO_2e kg /year**
O R Tambo	British Airways 6285	7	99,701.00	16,382,868.32
O R Tambo	British Airways 6283	3	3,481.00	571,997.92
O R Tambo	South African Airways	7	99,701.00	16,382,868.32
O R Tambo	Air Zimbabwe	2	28,486.00	4,680,819.52
O R Tambo	Fast Jet	3	3,481.00	571,997.92
Nairobi	Kenyan Airways	2	27,390.00	4,500,724.80
Addis Ababa	Ethiopian Airways	4	46,640.80	7,664,016.26
Harare	Air Zimbabwe 322	6	37,914.00	6,230,028.48
Harare	Fly Africa Zimbabwe 162	4	25,276.00	4,153,352.32
Harare	Fast Jet 8001	7	44,233.00	7,268,366.56
Harare	Fast Jet 8003	2	12,638.00	2,076,676.16
Bulawayo	Air Zimbabwe 326	1	5,333.00	876,318.56
Bulawayo	Fly Africa Zimbabwe 191	4	20,932.00	3,439,546.24
Windhoek	Air Namibia 405	4	53,490.00	8,789,476.80
Cape Town	Kenyan Airways 793	3	26,745.00	4,394,738.40
Cape Town	South African Airways 8690	6	18,412.00	3,025,459.84
Total VFA Airport	**Total Airport**		**553,853.80**	**91,009,256.00**
			Livingstone International Airport	
O R Tambo	British Airways 6291	7	69,720.00	11,456,390.40
O R Tambo	South African Airways 48	7	69,720.00	11,456,390.40
Nelspruit	South African Airways 8870	7	35,504.00	5,834,017.28
Nairobi	Kenya Airways 782	3	41,625.00	6,839,820.00
Livingstone	Proflight Zambia 704	4	4,516.00	742,069.12
Livingstone	Proflight Zambia 700,702,706	5	5,645.00	927,586.40
Livingstone	Proflight Zambia 708	7	7,903.00	1,298,620.96
Grand Total	**Total Airport**		**234,633.00**	**38,554,894.56**
			Kasane International Airport	
O R Tambo	South African Airways 8306	7	62,034.00	10,193,426.88
Maun	Air Botswana 34	2	2,654.00	436,105.28
Gaberone	Air Botswana 26,24	3	6,168.00	1,013,525.76
Airport Total	**Total Airport**		**70,856.00**	**11,643,057.92**
	Total All Airports			**141,207,208.48**

- Emissions per week= $Leg\ fuel\ burn\ \times the\ number\ of\ flights\ (legs/week)$
- Annual emissions = $fuel\ burn\ per\ week \times\ 3.15\ (constant\ ) x\ 52\ (\ weeks\ in\ a\ year)$ (IATA, 2015).

Source: Fieldwork (2017)

Total carbon emissions for flights to the VFA for one year equates to about 100 321 CO_2e tons per year, while Kasane International Airport (BBK), and Livingstone International Airport (LVI) produce 12 000 and 44 000 tons of CO_2e respectively. According to the USA EPA GHG equivalencies calculator, the amount of carbon produced by the VFA equates to the energy use of 9 610 homes for one year. Making

use of the USA EPA calculator revealed that to sequestrate this tonnage from the atmosphere, the airline industry to Victoria Falls will have to grow about 2.4 million tree seedlings for ten years to offset its emissions for each year as of 2017.

Given that most tourists to Victoria Falls use the OR Tambo International Airport as the leading continental air hub, there are many flights that fly to the Victoria Falls. Consequently, flights from South Africa account for a significant percentage carbon footprint, standing at an approximate 93 642CO_2 tonnes. The EPA calculator shows that to sequestrate their carbon emissions, the airlines must plant about 2.2 million tree seedlings for ten years or put up about 23 wind turbines to switch to renewable energy.

Overall, all flights to Kasane, Livingstone and the VFA contribute 155,654 CO_2e tonnes into the atmosphere annually. This amounts to about 3 000 passenger vehicles driven for one year or the energy use of about 15 000 homes for one year, according to the EPA calculator. According to the USA EPA carbon equivalent calculator, to sequestrate their carbon emissions, the aviation industry must plant about 3.7 million tree seedlings grown for 10 years for each year of flying into the Victoria Falls area as of 2017. The number of trees that need to be grown to sequestrate the carbon emissions seems to be very high, and it is highly unlikely that the aviation industry will meet this target, even with the best intentions. As such, it is expected that the carbon emissions from the aviation sector for these airports will continue to grow for the foreseeable future. However, there is an opportunity for development in this sector, since financing from the aviation industry could create green jobs in other carbon-offsetting projects.

The global and Zimbabwean tourism industry is set to continue to grow in the foreseeable future (IATA, 2017b). The anticipated growth will result in increased human and air traffic to the region, which will increase the direct and indirect carbon emissions for the tourism industry in the area. All things being equal, the entrance of new airline carriers is a likely indication of what is to be expected in the Victoria Falls area in the future.

7.2.2 Emerging carbon reduction initiatives

Given the airline industry's contribution to global warming, airlines have been under pressure to mitigate climate change, resulting in the adoption of several initiatives under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). ICAO was mandated by UNFCC under the Paris Agreement on Climate Change (2014) to adopt carbon reduction initiatives for the aviation sector. It emerged from secondary data that there are various reporting standards currently being used by different airlines on the Victoria Falls route. This is contrary to industry best practice, which prescribes the use of internationally acclaimed and transparent reporting systems such as the GHG Protocol Corporate Accounting and Reporting Standard (Revised edition) (hereafter called the GHG Protocol) from the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSA) published first in 2004 (WRI and WBCSD, 2004). The GHG Protocol is aligned with IPCC best practice. It comprises 11 areas where businesses can focus on dealing with their GHG emissions. The areas include providing guidance on GHG accounting and reporting principles, business goals and inventory design, tracking emissions over time, identifying and calculating GHG emissions, and verification of GHG emissions (WRI and WBCSD, 2011).

Table 7.3 summarises most common initiatives that are in place to deal with GHG emissions on the route. However, during the research, it emerged that there are only a few airlines that are transparent regarding how they deal with carbon emissions, with most parastatal and low-cost airlines seemingly operating in the shadows. This could be attributed to the fact that most of these airlines are poorly administered, with almost all of them operating at a loss and depending on government bailouts despite the good performance of the aviation sector in other parts of the world (IATA, 2017a). Carbon reduction appears to be the least of most airlines' worries with some failing to publish the mandatory annual financial reports due to viability and management challenges.

Table 7.3: Carbon emission offsetting initiatives by various airlines

Airline	Emission reduction targets Set.	Audit per scope (1, 2 & 3)	Reducing fossil dependency	Energy & water saving/ efficiency initiatives	Waste Minimisation and recycling initiatives	Carbon offsetting initiatives	Fleet modernisation and operational efficiency initiatives
South African Airways	√	√	√	√	√	√	√
SA Airlink	√	√		√	√	√	√
Comair	√	√	√	√	√	√	√
Fast Jet Africa	-	-	-	-	-	-	-
Air Zimbabwe	-	-	-	-	-	-	-
Ethiopian Airways	-	-	-	-	-	√	√
Kenya Airways	√	-	√	√	-	√	√
Air Namibia	√	-	-	√	√	√	√

Source: Field work (2017)

A review of publicly available reports showed that only Comair and SA Airlink provide comprehensive annual reports on their operations with clear baseline figures, present and future forecast of GHG. Air Namibia and Kenya Airways worked with their national civil aviation companies in developing strategies for addressing climate change. These strategy documents were publicly available on the ICAO website. The other airlines like the SAA and Ethiopian Airways provide a statement of intent and what they are doing with no concrete, publicly available, verifiable figures such as the baseline year and their total carbon equivalent amount. Only a few airlines indicated the amount of carbon being offset by their initiatives, making it difficult to verify the effectiveness of the current offsetting initiatives. Efforts to obtain data for budget airlines on the route were fruitless. A closer look at Comair's financial report for 2016, Air Namibia's Action Plan for CO_2 Reduction in International Aviation 2016, Kenya's Action Plan for Reduction of CO_2 Gas Emissions in Aviation sector for 2015 and the SA Airlink 2015 financial report shows the extent to which airlines have gone in reducing GHG after the base year. This makes it easier for companies to track the effectiveness of their intervention strategies. The absence of emission figures in most of the cases makes it difficult to know whether these airlines will meet their targets for carbon reduction by

2020 in line with ICAO claims. This seems to confirm suspicion, speculation and fears that ICAO and the aviation sector often lack seriousness and transparency in dealing with climate change although the sector is a significant carbon emitter (Scott et al., 2016b).

While there are claims by the aviation sector that significant strides have been made to reduce the carbon footprint, these claims are often not backed by clear evidence. Reviewed financial and sustainability reports have indicated that even the airlines that were doing their utmost to reduce carbon emissions had their carbon footprints growing as demand for travel increased due to increased traffic and growth in business.

The aviation industry in Africa is often run by governments, and viability is often a challenge due to poor management, over-taxation of the sector and corruption, among other challenges cited by Njoya (2016). Withstanding these challenges, there is potential for the aviation sector to reduce its emission levels and become greener than what it is now. Most airlines seem to have aligned their carbon offsetting initiatives with ICAO's recommendation for global carbon measures in dealing with climate change combined with operational efficiency.

Some airlines are taking initiatives to address their Scope 1, 2 and 3 emissions. Scope 1 emissions are direct GHG emissions within the organisation's boundaries, emanating from what the company owns or controls, in this case, mobile fuel from company-owned aircraft and vehicles (WRI, 2009). Scope 2 emissions emanate from electricity and Scope 3 entails other indirect GHG emissions such as water use, material use and waste disposal. The researchers noted that the most rewarding carbon reduction initiative is the acquisition of new generation airlines that are fuel efficient and more environmentally friendly. At least five airlines indicated that they were purchasing new fleet as a measure of reducing carbon emissions. The following subsections deal with initiatives to reduce carbon on a Scope-by-Scope basis, starting with Scope 1.

7.2.3 Scope 1 initiatives

SA Express (2016) and SAA (2016) reports indicate that SA Airlink and SAA had effected the Continuous Descent Approach (CDA) resulting in reduced fuel burn.

Through this initiative, the two airlines managed to reduce fuel burn on approach to landing, saving about 37 km worth of fuel on approaching the airport. Also, at least about 18 km worth of fuel is saved during take-off through the same initiative with each trip. A reduction in fuel burn means a reduction in carbon emissions. Furthermore, SA Airlink initiated a single-engine taxi programme.

Comair initiated a raft of measures to reduce its Scope 1, 2 and 3 emissions (Comair, 2017). These included the use of fixed ground, instead of the old method of using auxiliary power units, paperless cockpits, reduction in the potable water on board, use of borehole water and lessening the number of aircraft galleys to reduce weight on board. Besides implementing CAD that led to a 1.4% emission decrease on its entire fleet, Comair went further and retrofitted its B737-800 with Scimitar split winglets. This led to its older generation fleet reducing emissions by 2% during the 2016 financial period. The addition and purchase of new B737-800 with the capacity to carry 21 more passengers and a reduction of 200l per hour less fuel than its old B737-400 led to a reduction in carbon emissions per journey. Since the 2011 base year, the company managed to keep its emission growth in check at 2%, while recording an aviation footprint per passenger intensity reduction of 14%. Regardless of the increase in the number of routes, this offers a glimmer of hope that aviation efforts are somewhat paying some dividends.

According to the Kenya Civil Aviation Authority (2015), Kenya Airways adopted a range of measures to reduce carbon emissions from its operational activities in line with IATA principles. At least 43% of carbon reductions were from its flight dispatch, 33% from flight operations, and 14% from maintenance and engineering, with the remaining 10% being accounted for through its ground operation and commercial activities. Table 7.4 outlines the various activities and initiatives that have been taken to reduce the carbon emissions in the areas identified above.

Table 7.4: Kenya Airways carbon reduction initiatives

Flight Dispatch	Flight Operations	Maintenance and Engineering	Ground Operations and Commercial
○ Optimising cost Index ○ Flight Plan Optimisation ○ Alternate selection /No ALTN IFR ○ Contingency fuel reduction from 5% to 3% ○ Reduction of Pilot/ Dispatcher Additional Fuel ○ Zero Fuel Weight Accuracy ○ Mission Management	○ APU utilisation ○ Optimised Taxi Fuel ○ Engine Out Taxi ○ Reduced flap take off ○ Reduced Acceleration Altitude ○ Low noise low drag Approaches ○ Continuous Descent Approaches ○ Reduced flap landing ○ Idle Reverse on Landing ○ Pilot Technique and Flight Management	○ Weight reduction ○ Moisture insulation blankets, fly away kit ○ Onboard weight: dirt, dust, over paint ○ Drag reduction through the rigging of aircraft panels, doors and seals ○ Paint and cleanliness ○ Engine Improvement ○ Engine care wash, engine build fuel efficiency	○ Onboard weight reduction; catering carts, and galley equipment, duty-free carts, cargo containers and pallets, magazines and newspapers ○

Source: Adapted from Kenya Civil Aviation Authority (2015:21)

Regarding efforts to reduce carbon emissions from the aviation, Kenya Airways seems to be leading with regard to what they are doing with the assistance of the ICAO-EU Assistance project on Capacity Building for CO2 Mitigation from International Aviation. The combined effort of civil society and government seems to pay dividends in this regard.

Air Namibia understands that its operations have a detrimental effect on the environment. In a bid to align its operations to Namibia's National Climate Change policy (Government of Namibia, 2011), the airline adopted measures to reduce its operational carbon footprint. It drew many lessons from guidelines given by ICAO and implemented some measures to reduces its carbon footprint. Table 7.5 highlights some of the strategies and activities that have been adopted by the airline with the backing of the Directorate of Civil Aviation in Namibia. The measures can be categorised into three broad areas, namely (1) improved air traffic management (ATM) and infrastructure use, (2) more efficient operations, and (3) monitoring and data resources. In 2016 the airline sought to cut its emissions by 101 667kg of fuel within a year.

Table 7.5: Air Namibia carbon emission reduction measures

Measure	**Description of the measures being taken**	**Expected results / CO_2 reduced per annum**
Efficient operation measures		
Weight minimisation	○ Matching fuel requirements to flight plan minimum fuel requirements ○ Paperless cockpit through the removal of paper manuals ○ Use of closer arrival alternates ○ Making use of light material apparatus such as trolleys and cutlery on board ○ Reduction of onboard magazines two only $^2/_3$ of flight population ○ Reducing potable water by 50% (leading to 57.9 tonnes of CO_2)	321 tonnes
Minimising/ delaying flaps (take-off and landing)	Pilots institute as part of standard operating procedures ○ Low drag approaches	Not quantified

	○ Reduce flaps take-off ○ Reduce flap landings	
Reversers use	Idle reverse on landing	633 tonnes
Flying cost index	○ Dynamic cost index	686.6 tonnes
APU vs GPU usage		5 356 tonnes
Aircraft maintenance	○ Engine wash as part of maintenance ○ Maintain aerodynamically clean aircraft that is flush skin repairs and immaculate flight control surface rigging ○ Engine quality checks to ensure a return to original fuel mileage	Not quantified
CO_2 Mitigation measures implemented and ongoing		
Improvement of optimum flight altitudes	○ Provision of optimum routing for aircrafts ○ Track mile reduction initiative ○ Performance-based procedures (PBN) procedure implementation	Achieve best fuel burn efficiency to attain optimum operating levels
Optimum routing	○ Application of flight planning optimisation both vertical and lateral	Track mile reduction is resulting in 10NM saving Reduction of 1 929 097kg of CO_2
Application of reduced acceleration altitude (flaps retraction level-off)		Not quantified
Optimised cost index	○ Best cost index for operation	Optimum fuel burn efficiency
Better approach procedures	○ Use of required navigation procedure (RNP) and Area Positive Control Procedures (PBN)	Reduction of weather-induced diversions

Source: Adapted from Directorate of Civil Aviation (2016)

7.2.4 Scope 2 and 3 emission measures

Three airline companies, namely the SA Airlink, SAA and Comair indicated that they were making frantic efforts to deal with Scope 2 and Scope 3 emissions (Comair, 2017; SA Express, 2016; SAA, 2016). The companies indicated that they were involved in waste minimisation and recycling and implemented water-saving measures such as rescheduling their garden irrigation to reschedule their direct and indirect emissions. However, there was an indication that they were having problems in recycling some of the waste from aircraft due to the restrictive legislative framework. Comair, in a bid to reduce its carbon footprint, had embarked on the use of liquid petroleum gas for catering purposes, marshalled the use of light emitting diode (LED) lights and use of borehole water wherever possible. The three airlines also indicated that they had taken steps to change the light bulbs and lighting to achieve a more energy-efficient lighting system. Borehole water was reportedly used wherever possible. In Kenya, the Kenya Airports Authority was making frantic efforts to introduce the use of sustainable fuels in vehicles that are used at the airport as a carbon reduction measure.

7.2.5 Carbon-offsetting initiatives

In their reporting, Comair, SA Airlink, SAA, Kenya Airways and Ethiopian Airways noted that they have a facility that complies with IATA. Such a facility is where passengers are encouraged when making online bookings to donate to offset passenger's carbon footprint for the journey. Various airlines offered various programmes aimed at protecting the environment although there was no evidence of how these monies were reported in financial reports or how such funds were used.

The SAA and its franchise SA Airlink are involved in projects that provide solar geysers for heating water in rural communities, reducing energy demand on the grid and switching onto green energy. In partnership with other organisations, SAA had embarked on the utilisation of the Solaris strain of tobacco to produce sustainable fuels. The project had many benefits of empowering the local farmers in skills development and economically empowered the community and provided cleaner fuel. Such initiatives are commendable as they address broader aspects of the green economy. The company has an ambitious

project of having its head office running 100% on green energy. They also claim that their environmental policy is communicated to all their suppliers.

Other offsets projects supported by carbon offsets funds from passengers included renewable energy projects, wildlife conservation and tree planting projects, which support the claim that airlines were leading in climate change action. Only SAA and SA Airlink reported that they were involved in cleaner energy production. Challenges noted in this project will see the two airlines failing to meet the envisaged 2020 emission targets. However, some of the projects that were reported to be used for offsetting carbon emissions were too small to make a significant contribution to carbon reduction initiatives. Investment in Sustainable Aviation Fuels (SAF), like the one SAA, embarked on, is touted to respond to all the 17 United Nations Sustainable Development Goals (ICAO, 2017a). The biofuel project can be used to claim carbon credits as it qualifies to be classified as part of the Clean Development Mechanism in respect of United Nations Framework Convention on Climate Change established under the Kyoto Protocol (ICAO, 2017b).

Ethiopian Airways claimed that it was running a vast tree-planting initiative where it seeks to plant 7.5 million tree seedlings. These seedlings may not be sufficient to cover that airline's fleet size or to offset the carbon footprint.

It is important to note that some projects, although small, were found to be of the right framework with the capacity to meet the socio-economic and environmental aspirations of countries as they address the nine pillars of a green economy as noted by Law *et al.* (2015). Projects such as the SAA's Solaris biofuel project may result in economic development, skills transfer to the agricultural sector and environmental protection. At the same time, wildlife conservation may ensure the sustainability of the tourism industry that is the mainstay of some economies in Africa, employing thousands of skilled and semi-skilled labourers. Economically empowered groups and individuals are better capacitated to deal with the vagaries of climate change than poor communities.

The study found that external support and government assistance were seen to foster more dedicated initiatives in reducing carbon emissions in the likes of Kenya Airways and Air Namibia. This cements the argument that for a robust cut in carbon emissions there

is a need for combined effort between the state and other actors. Development partners were seen to play a key role in leading carbon emissions in the case of Kenya, and other countries such as Botswana are now drawing lessons from the Kenyan experience (IATA, 2017). However, the challenge is that all the carbon offsetting projects might not assist Zimbabwe in any way although it bears the brunt of global warming and climate change.

Kenya Airways has adopted a three-fold approach in its quest to offset its carbon emissions with the aim of achieving carbon neutrality by 2020. According to the Kenya Civil Aviation Authority (KCAA, 2015), these initiatives include the following:

- Allowing passengers to participate in voluntary pay for their carbon emissions during the booking process. The funds generated from this initiative are used to rehabilitate the Kasigau Corridor which is attempted through the Reducing Emissions from Deforestation and Forest Degradation (REDD+) project located in Voi.
- Maintaining a young fleet that is fuel efficient and retiring old aircraft. Kenya's fleet is less than five years old.
- Embarking on the afforestation project as part of their corporate social responsibility. This initiative has witnessed the growth of about 750,000 indigenous trees in Ngong Forest.

In as much as airlines have grand ambitions, evidence shows that carbon emissions from aviation will continue to grow for the foreseeable future, spurred by growing demand for air transport driven by international tourism and global trade. Experts point out that even with the best intentions, SAF that are being proposed to deliver green aviation together with other measures will not be enough to contain emissions from the aviation industry due to several factors that will need to be tackled at policy and practical level. The ICAO (2017c) argues that for meaningful benefits to be derived from SAF there are four broader areas that need to be addressed:

- Provision of volume-linked support aimed at addressing issues to do with import tariffs, blending obligations and having quota mechanisms for biofuels among other such issues;

- Provision of subsidy – both input and output subsidy –addressing excise tax credit, green vehicle purchasing subsidy and GHG emission level based subsidy;
- Assistance for the establishment of production through the provision of capital grants, loan grants and/or crop insurance for SAF farmers;
- Assistance for research and development and provision of a tax credit for investment in technology.

The capacity to deliver SAF globally remains low with the industry producing approximately 15 million litres in 2016 (ICAO, 2017d). This figure represents approximately 2% of global aviation fuel demand (ICAO, 2017e). The dream of carbon-neutral growth, therefore, remains elusive and it might only be practically realised much after the 2020 and 2050 set targets. In general, the growth of SAF will require that land for agriculture be drastically increased, producing agricultural land which will result in land clearance and subsequent production of carbon emissions which might upset the goals of such an initiative. Yilmaz and Atmanli (2017:1383), support this view, further noting that the success of SAF was threatened by “environmental problems, distribution challenges, feedstock availability and sustainability and compatibility with conventional fuels”.

7.2.6 Victoria Falls International Airport green initiative

Our field observations revealed that the construction and upgrading of the Victoria Falls were done in an environmentally friendly manner following some of the best practice in airport construction. The airport was designed in an energy-efficient manner that made use of natural lighting during the day. The reduction in lighting requirements is a positive step as it reduces the GHG emissions that are generated using electricity when lighting during the day or at night. It was noted that there was extensive use of local resources in the furnishing and building, a move that reduced the carbon footprint of the airport as shown in Figure 7.3. The utilisation of local resources helps in reducing both the Scope 2 and Scope 3 emissions by transportation of materials over a long distance.

Figure 7:3: The new Victoria Falls International Airport

Source: Fieldwork (2017)

The airport is largely energy efficient as it utilises double-glazed windows, window tinting and variable shading in a manner that allows natural lighting and ensures internal temperature control. The airport utilises LED lights, which are touted as the most energy-efficient type of lighting. The material that was used outside reflects much longwave radiation, which helps in reducing the demand for air conditioning in the hot and humid summer months that are synonymous with the area. Double-glazed windows serve a dual purpose: firstly, to reduce noise and secondly to ensure thermal comfort, especially during cold winter months. This further reduces the demand for electricity, as using air-conditioning in both the cold winter and the hot summer months results in energy cost savings and the associated carbon cost for the airport. Llummar films also help in blocking ultraviolet radiation and reject about 84% of solar heat, something that is advantageous for the tourism sector in the peak hot months of October and November. The window products also cover vehicles and block up to 87% of the sun's glare and heat (Llumar, 2017).

To some extent, the VFA meets the provisions set by the Airports Council International for a green airport. The VFA put in place such initiatives as reduced taxiing and queuing time when an aircraft is arriving or departing. The airport further reduced taxiing distance through the intelligent configuration of the runway and wise management of arrival of

aircraft to provide gates as soon as an aircraft arrives to assist in reducing the waiting time and fuel burn.

There is, however, a need for the airport to put measures in place which will reduce its Scope 2 and 3 emissions. The airport is 20 km from the Victoria Falls town, and there is no rapid public or train transport that carry the tourists to their hotels that are in the town and surrounding areas. The extensive use of meter taxis rented cars and shuttles is not environmentally friendly as the huge fleet utilised to ferry tourists results in colossal carbon footprint. It is suggested that the airport working alongside other stakeholders could introduce a train service between the airport and the town or introduce a rapid bus transport system to save on fossil fuel and reduce the carbon footprint.

The VFA has a large parking space for vehicles, but it does not have any shade for vehicles. After some time of parking, the vehicles become very hot due to excessive heat from the sun and require a lot more fuel to cool by using the air-conditioning system.

7.2.7 Impact of Climate Change on Aviation in Victoria Falls

Aviation specialists at the newly constructed Victoria Falls International Airport indicated that the continued temperature increase was detrimental to air traffic in the area. Increased temperature reportedly led to increased clear air turbulence, which could result in uncomfortable flying and injuries in worst case scenarios, even death. They warned that temperatures above 35°C require flights to have longer runways and load shedding. Such high temperatures result in the thinning of air, adversely affecting aircraft engine operations. Such trends could result in air tickets costs to Victoria Falls becoming higher as insurance premiums for airlines goes higher to cater for the increased risk. Load shedding further has a potential for increased costs of airlines and in cases where landing is aborted. From the account, such incidents were reported at the nearer Kariba Airport. The findings confirm claims by Coffel et al., (2017) on the detrimental effect of increased temperatures on passenger aircraft.

7.3 Carbon Emissions from the Hospitality Sector

This section deals with the sources of GHG from the hospitality sector that include GHG emissions from accommodation establishments. It maps out the various sources of GHGs throughout its value chain that includes hospitality, attraction and the transport subsector. The section further explores some best practice that can be adopted by the hospitality to make it eco-friendlier.

7.3.1 Sources of Emissions

The hospitality sector contributes about 20% of the tourism industry carbon emissions which is about 1% of total global carbon emissions (UNWTO, 2007). From the field observations, it emerged that the Victoria Falls accommodation establishments are primarily constructed and designed in a manner that took into consideration the concept of sustainability. Although the idea of green tourism is relatively new, conservation was a significant consideration in infrastructure development as a government requirement since the resort is located within the Victoria Falls National Park. In 2016, a total of ten (about 20% of total) accommodation establishments were accredited as green accommodation establishments by Green Tourism in collaboration with Environment Africa and Zimbabwe Tourism.

The primary source of GHG emission comes from the hospitality sector. The hospitality sector emits GHGs through lighting, heating, cooling and cooking. Out of 50 out of about 60 recognized accommodation establishments that participated in the research, all of them indicated that their operations were mostly dependent on electricity. This poses challenges as the bulk of local and imported electricity is produced from coal with coal sources ranging between 50 and 67% of the energy mix. As such the use of electricity comes with a huge carbon footprint. However, most establishments were using Liquefied Petroleum Gas for cooking in 70% of the time. This is due to the unreliability of electricity supply system (Zimbabwe has a power deficit of about 1000MW) in the country and to cut on ‘expensive’ electricity costs (Netherlands Enterprise Agency, 2017).

The Victoria Falls area is a very warm area, and temperatures increase quite high in the summer months and the humid hot months of October and November especially and can

make the environment quite uncomfortable (Dube and Nhamo, 2018a; Dube and Nhamo 2018b). As a consequence, there is a considerable investment in air conditioners which uses much electricity. Increased energy demand due to use of air conditioners during summer months is not unique to Zimbabwe as Arcuri et al. (2017), observed an energy spike during summer months due to increased cooling demands in Brazil commercial buildings. However, it emerged that most of the technology and equipment used by hoteliers is very old and not as energy efficient as one would require in the context of global warming. As such, the hoteliers could acquire and use a modern energy efficient air condition system which would both decrease the hotel's carbon footprint and energy costs.

Mearns and Boshoff (2017), observed a link between carbon intensity and appliance age. The researchers noted that 80% of the sample population made use of air conditioners with the remaining percentages using of fans and other cooling technologies. Air conditioning, therefore, was a significant energy user in tourism establishments as confirmed by stakeholders. It also emerged that there was no consideration of energy efficiency in the purchase of such technology with the bulk of the air conditioners being very old and less energy efficiency. It also emerged that the building designs did not have air conditioner installation in mind and most cases it was found to be an afterthought as building designs did not meet specifications for the airconditioned environment about room floor size, window glazing and facing direction and insulation standards. As a consequent, more energy was used than what will be ordinarily required for cooling purposes, which increased the carbon footprint. Figure 7.4 shows an example of some of the air conditioners used in some accommodation establishments.

Figure 7:4: Air Conditioning system in one of the hotels in Victoria Falls

Source: Fieldwork (2017)

The hospitality subsector players indicated that most of their geysers were very old as well and heavy on electricity, which increased their utility bills and ultimately the carbon footprint. This confirms findings by Mearns and Boshoff (2017), who observed that most old technologies and appliance in use in hotels were heavy energy inefficient and had a carbon footprint.

The results show that the hospitality sector has a considerable vehicle fleet size, which is used for shuttling tourists around and for operations, which contributes to GHG emissions. Given the prevailing economic environment in Zimbabwe, there is extensive use of second hand and cheap imported cars from Japan. These cars come with inherent huge carbon footprint on the environment and industry. Most players in the sector are forced to overlook the demand for green transport in their businesses as operators struggle to stay afloat or maximise profits. This brings about the question of the impact of political instability and how it affects the mitigation of climate change in the tourism sector. All the transport operators' needs is a car that can be used to transport tourists. Climate change, therefore, becomes a peripheral issue where business survival is threatened by either external or internal factors although some wastage was reported in other areas.

There seems to be a high-water-use in most accommodation establishments, which adds to the carbon footprint. The researchers noted that the bathrooms in the town by and large are not designed in a water-efficient manner. Only three accommodation establishments

have a cistern that utilises a dual cistern system with none of them making use of the world famous five-star Profile 5 cistern with Integrated Hand Basin. The use of old shower system demanded more water and consequently more heating demand further ballooning the carbon footprint and operational costs.

About 80% of sampled hospitality establishments were reported to also have sizeable expansive swimming pools and huge fountains. Such lead to high water usage and loss, especially during the dry summer months. The configuration of the swimming pools makes them vulnerable to high rates of evaporation, especially during the hot summer months (Figure 7.5). A few establishments used flooding and water sprinklers, which are known to be wasteful regarding water usage. Visits to the establishments noted that garden watering was done during the day, which results in high evaporation and reduces effective moisture. In some cases, sprinklers were not attended to resulting in water floods in the gardens. The use of treated water which comes with a high electricity bill comes at a huge carbon footprint which increases the Scope 3 emissions of the hospitality subsector in Victoria Falls.

Figure 7:5: Large Open swimming pools, water features and irrigation springers characteristic of Victoria Falls

Source: Fieldwork (2017)

The hospitality sector has not embraced the latest technology in energy savings, which is almost standard in most establishments worldwide. They still depend on mechanical ways of doing things such as switching off electricity in none occupied hotel wings during low occupancy. Most hotels would likely save more energy and money through automated switching on lighting that is linked to hotel card or make use of motion detectors to switch on and off depending on occupancy. The low uptake of the solar heating system in a region that has an abundance of sunlight is a sad loss as significant gains and savings can be made through green energy switching.

7.3.2 Mitigation and Carbon Reduction initiatives

Since the Victoria Falls is a town located in between national parks (the Zambezi National Park on Zambian side and The Victoria Falls National Park on Zimbabwean side), the model for construction development follows the ideals of responsible and sustainable development as noted earlier on. About 92% of accommodation establishments, except for four, made use of local resources in the design processes with most roofing being done in local thatch grass. The thatched grass was acquired from locals who harvest it sustainably during late winter using sickle which helps to reduce fire fuel load. Selling of long thatch grass provides an extra source of income for host communities thereby contributing to the economic well-being and rural livelihood security. Thatched roofing is beneficial to this region as it is locally available, affordable and ensure that the roofs blend well with nature to maintain the pristineness and aesthetic value of this fragile ecosystem and blend well with the natural environment and local setting.

Thatched roofs are known to contribute towards energy efficiency as grass acts as heat regulators. Research participants indicated that thatched roofs tend to be warm in winter and cooler in summer. This goes a long way in reducing the electricity demand for heating and cooling in winter and summer respectively. In this sense, thatching is environmentally friendly as it helps in reducing the carbon footprint in the hospitality sector. Long (1978), argued that grass thatching in Africa offers many advantages as it was locally available. Further arguing that it offered best insulation value noting that a 150mm thick thatching has an insulation value of 0.65W/m^2 $^{\circ}$C for downward heat flow and 0.67W/m^2 $^{\circ}$C for upward heat flow from internal sources. This was comparable better to a galvanised steel

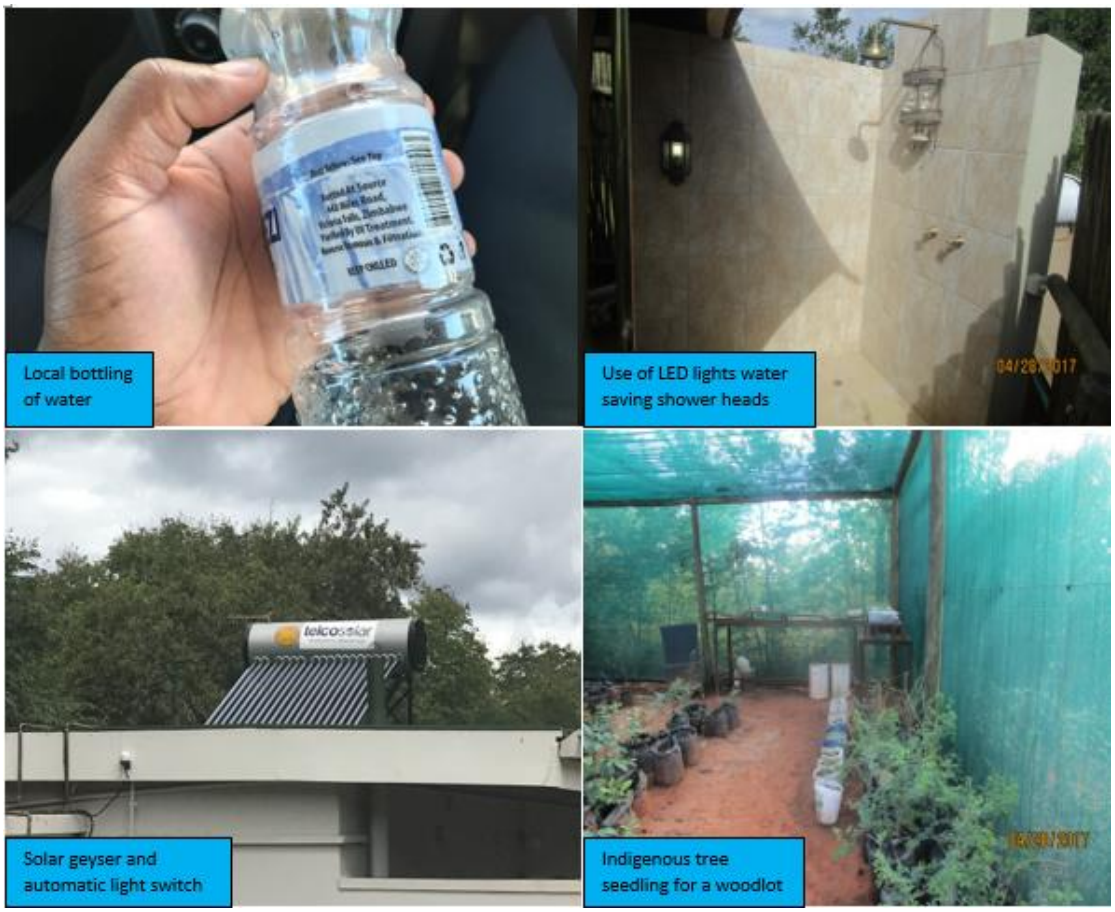
sheet with a 6mm thick gypsum plastered ceiling normal used which have a 0,68 W/m^2 ºC and 0.73 W/m^2 ºC respectively.

However, this comes with limitations for the hospitality sector as it does not allow for installation of solar geysers and other solar products due to fears of short circuits and ensuing fire. As such, there is limited use of solar energy in the resort that is widely dependent on the grid and generators for energy. Out of all the observed establishments, only three establishments made use of solar water geysers at their establishments. Water geysers are some of the high energy users in the hospitality sector under Scope 1.

Most of the hotels observed during the survey indicated that they were making strides in reducing the carbon footprint through local sourcing of products wherever possible to minimise their carbon footprint. This initiative leads to domestic economic growth and community empowerment. A good example was given where in previous years bottled water was outsourced from as far as Harare and South Africa. An effort has been made for local sourcing of bottled water, and most establishments served clients with locally bottled water.

While the bulk of establishments visited had not switched to renewable energy, they all had switched to LED lighting at their establishments as part of the drive to reduce energy consumption costs and carbon footprint. There is equally moderate use of water saving showerheads as a measure of reducing water and electricity consumption (Figure 7.6). It has to be noted that during the fieldwork, only one of the accommodation establishments had water and energy saving warning and tips for guests a departure from most hotel standard practice in the region.

Figure 7:6: Initiatives to offset GHG emission and reduce the carbon footprint



Source Field Work (2017)

One hospitality establishment mindful of its carbon footprint is growing indigenous trees as a measure of offsetting its carbon footprint and deal with deforestation. The same company is also involved in rehabilitating and providing health care for sick animals and those injured by snares put up by poachers. As part of the corporate social responsibility, the establishment provides environmental training to primary school students in the area every Friday afternoon to foster a culture of environmental consciousness. The company employed some youths and women who are responsible for ensuring that the stretch between Victoria Falls town and the Victoria Falls airport is kept clean always. These initiatives responded to the environmental and economic demands of the Victoria Falls community.

Another focus area was that the hospitality sector was actively engaged in waste recycling, reduction and reuse initiatives as per the demands of the national environmental regulatory authority, the Environmental Management Agency. However, they complained that in as much as they were involved in waste separation, this was a futile exercise as the local municipality could not collect separated waste. The hospitality role players indicated that all the separated waste was mixed upon collection by the town council workers. They also indicated that efforts to start a waste recycling company in the town had failed owing to various local governance challenges within the town council.

7.4 Tour operators and attraction sector

This section is aimed at outlining the GHG emissions from the tour operators and the attraction sectors. These sectors are both contributors and victims of climate change. The section further identifies some of the carbon reduction measures that can be put in place to reduce GHG emissions.

7.4.1 Sources of Emissions

Arguably, one of the most contributing sectors to GHGs in the resort town is the attraction and travel sector through its vast fleet size. Given Victoria Falls' small population size, the town boasts of a vast car population, which often results in traffic congestion. Most of these cars are owned by various tour operating companies. There is a considerable amount of 4x4 vehicles and a significant amount of ex Japanese cars that are used by visiting tourists. A combination of 4x4 and cheap Japanese imports results in significant carbon footprint by the cars as they use a lot of fossil fuels (see Figure 7.7).

Figure 7:7: Ex Japanese Cars and 4x4 exerts a huge carbon footprint

Source: Field Work (2017)

The other significant source of GHG emissions comes from the helicopter companies. There are about three verified helicopter companies with a fleet of 15 helicopters on the Zimbabwean side of the Victoria Falls. These helicopters offer a scenic aerial view of the Victoria Falls and the Zambezi River. Helicopter flights are a significant attraction for the more affluent tourists. On average each flight tour last about 15 minutes with helicopters in the air every single minute during the day if the weather permits.

Records from aviation companies in the area indicated that helicopters on average burn about 535 litres of Jet A1 fuel per hour depending on the weather for the day. This translates to about 423kg of fuel burn per hour in an 8-hour day, and about 3,384kg of fuel burnt in one day or about 1,231,776kg of Jet A1 fuel burnt in a year. According to the Greenhouse Gas Equivalencies Calculator, this consequently translates to about 1,358 CO_2e per year. According to the Greenhouse Gas Equivalencies Calculator to effectively offset this, the helicopter companies will have to grow about 31,923 tree seedlings for ten years for each year they fly according to EPA carbon equivalent calculator. There was no indication of carbon offsetting initiatives from this sector as they do not believe that their activities have a significant impact on global warming as they feel that their operations are 'of minor magnitude to the environment as compared to industries'. This level of ignorance humper efforts in dealing with carbon emissions. There is, therefore, a need for a mind shift in that regard for the industry to sail in a climate wise direction.

The other source of GHGs emanates from electricity that is used for lighting and powering computers. Printing of office and promotional material is another activity that contributes to the additional carbon footprint. Due to the unreliable power supply from the national power utility, most organisations supplement electricity supply with mobile generators for electricity, which uses fossil fuels. Although power supply has been relatively stable over the past two years, when there are shortages, there is a growing reliance on these generators. A small boat population on the Zambezi River borders well for the environment.

Tour operators in the area complained that coal-fired Rovos Rail Train was a major GHG contributor in the area as it produces enormous smog that darkens the area whenever it comes to the area.

7.4.2 Mitigation and Carbon Reduction Interventions

It was noted that the most predominant GHG reduction initiative in place for this industry in line with national legislation was waste separation and recycling. There is strict regulation with regards to how various attractions act. The Victoria Falls National park had initiatives of planting indigenous trees to reduce the carbon emissions emanating from the tourism value chain. Most attractions take afforestation seriously with ground observations and an aerial view showing that where there is human occupation, there is a better tree population as organisations strive to be as green as possible (See Figure 7.8). Vegetation around built-up areas also plays a critical role in regulating the temperature during the scorching summer months reducing the demand for artificial cooling in the area. Zhang et al. (2018), recommended the use of trees to improve summer comfort of outdoor environments and act as temperature regulators in both summer and winter months. On the other hand, Rong (2018), postulated that trees were advantageous in that they assisted in improving and protecting the space's ecological function. With regards to tourists, it creates many kinds of space for people and helps in adjusting the function of people's body and mind.

Figure 7:8: Map of Victoria Falls and the surrounding areas. More vegetation in constructed areas than surrounding areas

Source: Map adapted from Google Earth Image taken 13 October 2017.

Other initiatives undertaken include projects in poaching control, as well as the rehabilitation of sick and injured animals. Vultures that are threatened in most parts of Southern African are fed and kept in the Zambezi National Park. The feeding programme is aimed at ensuring that vultures do not go looking for food at dumb sites and places of residence where they were vulnerable to poaching and poisoning.

Most tour operators were going digital by utilising e-marketing to reach customers instead of utilising the brochures, which they said came with a huge carbon footprint. The tour companies made use of various platforms to communicate with customers, and potential customers are ranging from using Facebook, Twitter, YouTube, Google Plus, Blogs, websites and other web-based applications to increase their market share as opposed to traditional methods of marketing.

The tour operators indicated that although they sometimes fail to meet their targets, they realise the need to keep a well-serviced vehicle by sticking to manufacturer's car service intervals to ensure engine and fuel efficiency. This goes a long way in reducing the carbon footprint of various companies. Most managers indicated that they encouraged their

drivers to continually check tire pressure to manufacturers' specification to reduce frictional drag caused by low pressure, which results in more fuel burn. Other actions include closing windows wherever possible, reducing the use of air conditioning, avoiding over acceleration and harsh breaking as that leads to more fuel consumption. The use of LED lights in the area drastically reduces the overall carbon footprint from lighting. There is also evidence of extensive use of local construction materials in construction and decorating of office space, a move that reduces the area's carbon footprint. Some establishments are mounted with solar lights avoiding the conventional electricity from the national grid which is 40% powered by coal with 60% coming from hydroelectricity.

7.5 Conclusion

This chapter was aimed at mapping the sources of greenhouse gas emissions in the Victoria Falls resort and the Victoria Falls and establish ways of mitigating the carbon emissions. It emerged that one of the most significant carbon emission sources was the aviation sector. This was so given the high number of international flights and airports that surround the Victoria Falls resort. There are three international airports within a 100km radius. It was noted that the Victoria Falls International Airport has the most extensive carbon footprint as it is the busiest amongst the three airports. In fact, 16 out of the 26 airlines flying into the area land at the Victoria Falls International Airport. Given the fact that most international tourists access the Victoria Falls tourism hub through OR Tambo and Cape Town International Airports, the airlines from South Africa account for the biggest carbon footprint with a total of 93,642CO_2e out of 155,654CO_2e tonnes for the three airports.

To curtail the carbon footprint, several initiatives have been adopted by flights to Victoria Falls, especially those operating from South Africa. Such mitigation measures include the purchasing of new aircraft, retrofitting and the continuous descent approach. In line with the International Civil Aviation Organization regulations, the airlines have adopted a market approach in dealing with their emission challenges. Carbon offsets projects that were noted include the planting of trees, solar energy projects funding and animal conservation projects. Also, efforts are underway to switch to green fuels for airlines in the case of South African Airways and SA Airlink.

The other significant source of greenhouse gas emissions comes from the hospitality and tour operators. The Victoria Falls is mostly dependant on electricity from the power grid, whose energy mix is heavily reliant on coal. The tourism sector uses this energy for lighting and heating. Furthermore, the vehicles are heavy polluters. Although their carbon emissions could not be quantified due to poor record keeping, it is anticipated that the use of 4x4 vehicles and old second-hand cars condemned for pollution in Japan contributes a lot to greenhouse gas emissions in the town. The tourism industry has been making efforts to reduce their carbon footprint through local purchasing and where possible, recycling, reducing and reusing products, making use of thatching to reduce energy use, migration to light emitting diode, lighting and moving towards the use of solar energy, among other initiatives. The Green Tourism initiative is a further step in the right direction, which is expected to result in more players becoming more environmentally-friendly and sustainable in their operations. There is, therefore, a need for all the tourism players to embrace green tourism initiative to reduce the carbon footprint and ensure sustainability. Government leadership and policy intervention are necessary for ensuring that there is a reduction in as far as the issue of climate change is concerned.

Chapter 8 : Conclusion and Suggestions

8.1 Summary of the study

The study was aimed at examining and understanding the dual relationship between tourism and climate change on the Zimbabwean side of the Victoria Falls. To achieve this, the research identified three research objectives namely: (a) to determine evidence of climate change and associated extreme weather events on the Victoria Falls resort and potential intervention measures thereof, (b) to establish perceptions and attitudes of tourism role players on the impact of climate change on the Victoria Falls and vice versa and possible intervention measures for the future sustainability of the attraction, and lastly (c) to map out sources of greenhouse gas emissions (GHG) in the Victoria Falls resort tourism value chain and establish ways of mitigating these carbon emissions. As such three research questions were derived from the objectives and these were set out as follows: (i) What evidence of extreme climate-related weather events exists in the Victoria Falls resort and which appropriate intervention measures could be put in place? (ii) Which perceptions and attitudes on the impact of climate change on tourism and vice versa are prevalent and what possible intervention measures can be instituted? (iii) What are the sources of GHG emissions within the Victoria Falls resort tourism value chain and what appropriate mitigation measures are available to reduce such carbon emissions?

The research adopted a pragmatism paradigm in a case study research that made use of a mixed methodology approach. Numerous research tools were used in line with the demands of the research question and to triangulate data to ensure validity and reliability of the findings. To investigate the evidence of climate change, meteorological and hydrological data for 40 years from the Zimbabwean and Zambian meteorological departments and the Zambezi Water Authority were analysed respectively. Field observations and stakeholder interviews were undertaken as well. In addition, an online survey completed by 447 tourism stakeholders was undertaken. Expert stakeholder interviews and focus group discussions were also held. Other secondary data sources included reports from IATA and airline sustainability and financial reports.

Data analysis was done following established protocols of analysing both quantitative and qualitative data. Qualitative data analysis was done as informed by the thematic analysis theory, with ATLAS.ti used to aid the data analysis process. The online survey data were analysed simultaneously through an inbuilt QuestionPro statistical and text analysis function. Quantitative data were analysed using various software packages such as Mann-Kendall Trend Test (change detection), Statistical Package for the Social Sciences (SPSS) Statistics 24, Excel Analysis ToolPak, World Travel and Tourism Council (ICAO) carbon calculator and the United States Environmental Protection Agency (EPA) Greenhouse Gas Equivalencies Calculator. Furthermore, data were collected ethically in line with university regulations and national laws. In fact, an ethics clearance letter was issued by the University of South Africa following a rigorous review of the research instruments and protocols presented.

8.2 Summary of Findings

The following subsections present a summary of findings following the outline of the objectives and research questions.

8.2.1 Climate change in Victoria Falls

The study revealed evidence of climate change and extreme weather events in the Victoria Falls resort town. Of note are the statistically significant increase in temperature and a delay in rainfall onset as revealed by climate data from both the Victoria Falls and the Livingstone stations. The changes, however, were different from month to month, with other months recording much higher temperatures than others. The month of October showed a larger significant temperature increase of around 3°C over the past 40years (1976-2017) marking a temperature increase rate of about 0.75°C per decade for that month.

The other observation was that the winter month of June was warming at a rate of 0.33°C per decade. There was, however, no statistically significant rainfall changes over the period in question, although extreme annual fluctuation was noted. This points to extreme rainfall events and extreme drought patterns in the area. It was further observed that there is a statistically significant trend in the increase in annual water flow at the Victoria Falls

waterfalls during the same period. This was not expected. Nonetheless, marked monthly differences were noted in water flow at the waterfalls where some months recorded a water increase, while others recorded a water decline. This has resulted in fears that water may dry at the falls during October and November if the trend continues.

8.2.2 Perceptions and attitude of tourism and climate change

It emerged that there are growing concerns and knowledge on the causes and impacts of climate change by tourism stakeholders. The stakeholders (which included tourists, tourism business community, host community and support services) cited some challenges that impede the tackling of climate change by the tourism sector. Much as the level of climate change concern and knowledge is growing; the role players are at best doing the bare minimum to tackle climate change. This is because of the lack of knowledge, accountability and ignorance among other factors.

The role players fear that climate change will negatively affect the tourists' arrivals and Victoria Falls resort. Tourism role players report that they have observed changes in the Victoria Falls area and at the waterfalls that could be attributed to climate change. If climate change is to alter the waterfalls negatively, findings show that the resort could lose a big part of its tourism market. However, if the Victoria Falls dries up, the online survey results revealed that it could be a last chance tourism destination. This is a situation where there will be a huge rush of tourist to see the waterfalls before they dry. However, a complete dry up of the waterfalls could result in very few tourists visiting the area.

8.2.3 Mapping of GHG emissions

It emerged that the tourism industry is as much a victim of climate change as it is equally a major driver of climate change through carbon emission. Major sources of carbon emissions from the industry are from the travel sector through cars and airlines, the hospitality sector and the attraction sector through helicopters, amongst others. The carbon emissions from the airline industry are significant and will continue to grow even at the backdrop of technological innovations by the airline industry. Such technological interventions include fuel-efficient technology and biofuels. Carbon emission will rise

owing to the growth in demand of the aviation sector by the growth of the tourism sector and largely the old fleet that is used on this route. The old fleet is the biggest culprit in the production of GHG emissions in Victoria Falls. Other sources of GHG emissions are by the hospitality sector through electricity consumption in heating and cooling. The travel sector further produces carbon emissions from the large vehicle fleet, which at most is not environmentally friendly.

8.3 Conclusions

Based on findings from this study it emerged that climate in the Victoria Falls resort is changing at a faster pace than the envisaged global averages. It emerged that climate change and variability is resulting in the occurrence of extreme weather events such as severe droughts, extreme rainfall, and rising temperature. Such extreme events are mostly and negatively affecting wildlife and tourists in the area. Waterflow at the waterfalls has increased on an annual basis although some months have recorded a significant drop in water flow, which in turn have reduced the aesthetic of the waterfalls in October and November. Hence, climate change occurrence might result in disturbed tourist flow to the area depending on the severity of the negative impact of extreme weather events and changing climate. Changes in climate have a detrimental impact on the tourism industry value chain, with chances of negatively affecting the tourists visiting calendar for the resort. Climate change, therefore, is a potentially significant threat to the tourism industry sustainability in the Victoria Falls. On the other hand, tourism was found to be a driver of climate change through the production of carbon emissions mostly those coming from the travel and hospitality sector.

8.4 Suggestions

The following subsections present some suggested solutions to the challenges that have been raised in the research project which can be adopted to assist in climate adaptation and mitigation.

8.4.1 Continuous monitoring and evaluation of climate

The tourism industry is dependent on ideal climate conditions to prosper. Extreme weather events affect the tourist's comfort and occurrence of certain activities. In the

Victoria Falls, for example, helicopter view and flights are directly linked to clear skies and average temperatures. To this end, continuous monitoring and evaluation of weather conditions and hydrological cycles at the waterfalls are imperative. In addition, there will be a need to continuously inform the tourists and tourism role players on decisions such as what to pack for wearing or activities to undertake or not to undertake on a day. A constant revision of the climate change hydrological calendar is also necessary for informing planning processes. As highlighted earlier, the aviation industry and helicopter rides are particularly vulnerable to extreme weather events, and provision of accurate weather is critical in adaption and mitigation of the sensitive sector.

There is equally a need to protect the resort through a determination of a population threshold for the area. This is to protect it from environmental degradation and mass tourism associated carbon footprints. A carbon levy for all tourists out of the Victoria Falls if properly managed can assist the local community to adapt to climate change impact. Climate change is likely to result in increased water demand directly or indirectly, which might lead to increased water abstraction affecting the water flow at the Victoria Falls waterfall. The enforcement of transboundary agreements and integrated water resources management in the basin to protect the resort area will be a welcome development.

For the sustainability of the sector, there is a need to tackle and reduce carbon emissions by all sectors of the economy the tourism industry included. Transparency and accountability by all stakeholders will assist in efforts to achieve carbon neutrality.

8.4.2 Mitigation and Adaptation

There is a need to improve climate change knowledge across the tourism sector to assist in filling the knowledge gap to equip tourism players with necessary knowledge that allows them to act in an environmentally responsible manner. The United Nations Framework Convention on Climate Change and the Intergovernmental Panel on Climate Change, in collaboration with local government and other stakeholders, have a central role in climate change mitigation and adaptation. Climate change information should be provided in a simple and usable manner. The line ministry must cement climate change education and industry-specific policy and guideline on climate change. This will assist the industry in

mitigating and adapting to climate change. Incentives and grants can be provided to assist the tourism sector, particularly in the Victoria Falls to go green and build adaptation measures. Local government can also assist with putting in place by laws and regulations on new buildings and structures to ensure that they are energy and water efficient. Restrictions on carbon emissions and taxes can assist in ensuring that the aviation industry is transparent and complies with the industry best practice with regards to climate change mitigation. To expand knowledge and action, there is a need to include green tourism as part of the curriculum for tourism studies and to streamline climate change as part of the entire curriculum as climate change is one of the biggest threat to communities in Southern Africa.

8.5 Contribution to knowledge

The research made a modest contribution with regards to filling the knowledge gap as to the state and level of threat of climate change to the Victoria Falls resort that also hosts a world heritage site, the Victoria Falls. The research laid bare the weather and hydrological elements that have been altered as consequence of climate change. The study contributed to the understanding of the level of climate change and its potential implications for the tourism sector. Most importantly, the research covered the knowledge gap on water flow pattern at the waterfalls, which is the main attraction. The picture portrayed allowed for an understanding of the flow pattern regime and trends over the past 40 years and dispelled speculations featured in global media, among such, a drying Victoria Falls.

The drivers of climate change in the Victoria Falls resort were also outlaid. In addition, the research advanced knowledge on the knowledge levels and attitudes of ecotourists and tourism businesses who visit Victoria Falls, which are either detrimental to addressing or assist in tackling climate change. The research made a significant contribution in highlighting the two-way linkage between tourism and climate change. As such, major stakeholders like the United Nations Education Scientific and Cultural Organization, The Government of Zimbabwe, the tourism industry, local community, and academics t can tap and utilise the research in several ways to their benefit.

8.6 Suggested Further Research

The research found that the climate in the area is changing. However, what is not known is how exactly this will affect flora and fauna in this unique area as the study had to depend on experts and literature reference to published work elsewhere. The observation was that the weather in the area is becoming highly unpredictable with some models failing to predict what is going to happen in the future. It is necessary, therefore, for further research to find out the exact extent of the challenge to allow the government, community and other entities to make precise decisions. It was also not fully understood why the water flow is increasing at the waterfalls on an annual basis at a time where the expectation was high that water flow is declining. The basin changes attributed to this scenario has to be fully understood as such research focused on this is recommended. To reduce the impact of climate change on the aviation industry, there is still much research that needs to be done to make the industry carbon neutral. The emissions are set to continue to increase unless new and greener methods are found hence the need for dedicated research in that regard.

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